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THE ROYAL ENGINEERS JOURNAL.

Vol. I. No. 1. JANUARY, 1905.

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PREFACE TO NEW SERIES.

THE *Royal Engineers Journal* was started in 1870 as a monthly newspaper for private circulation amongst subscribers; it was published by a Committee in London. At first it included a "Distribution List of Officers of the Corps," but from January, 1873, this List was printed separately as a *Supplement*. The *Journal* proper contained:—(1) articles on military, technical and miscellaneous subjects, and (2) matter of a more or less private nature concerning the Royal Engineers and their various regimental institutions and funds. At the end of 1875 the publication was taken over by the Royal Engineers Institute, which had been founded early in the same year.

The *Professional Papers of the Corps of Royal Engineers* were commenced in 1837 for circulation amongst subscribers, and were also published by a Committee of officers in London. They included technical articles on subjects connected with the multifarious duties of the Corps, were issued in annual volumes, and were on sale to the general public. They were taken over by the Royal Engineers Institute in the year 1876.

The Committee of the Institute have recently decided that the requirements of the present day necessitate some modification in the form and period of the above publications.

From the commencement of the current year the *Professional Papers* will be issued in separate pamphlets, and will be bound in volumes when and as often as sufficient Papers have been printed to fill a volume of convenient size. They will be practically confined to contributions of a highly technical nature and to others which are necessarily accompanied by numerous illustrations.

The *Royal Engineers Journal* will be published as a magazine available for purchase by the public, and will contain articles of interest to the Army at large as well as those of a technical character. Matter of a purely private or regimental nature will be printed in a separate *Supplement* in the same size, the present *Supplement* retaining its folio shape but changing its title to the *Royal Engineers Monthly List*. These last two will be strictly limited to private circulation.

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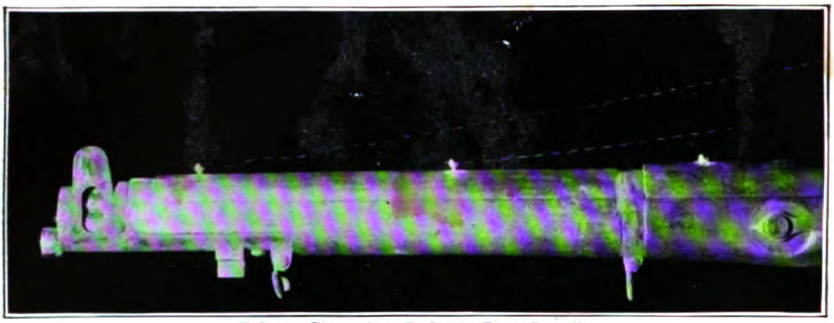

FIG. 1. Short Lee-Enfield—Free Recoil.

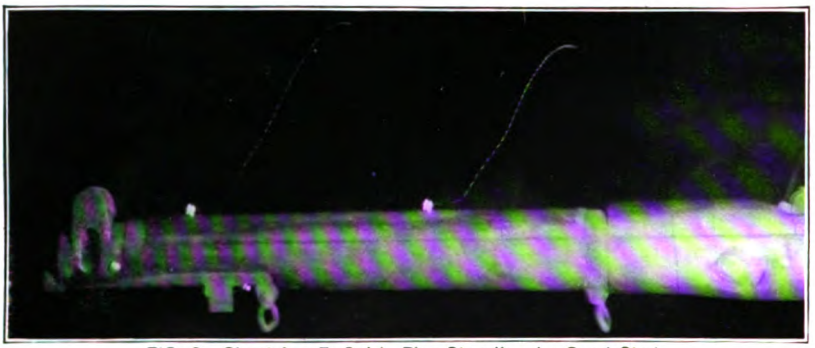

FIG. 2. Short Lee-Enfield—Fire Standing by Good Shot.

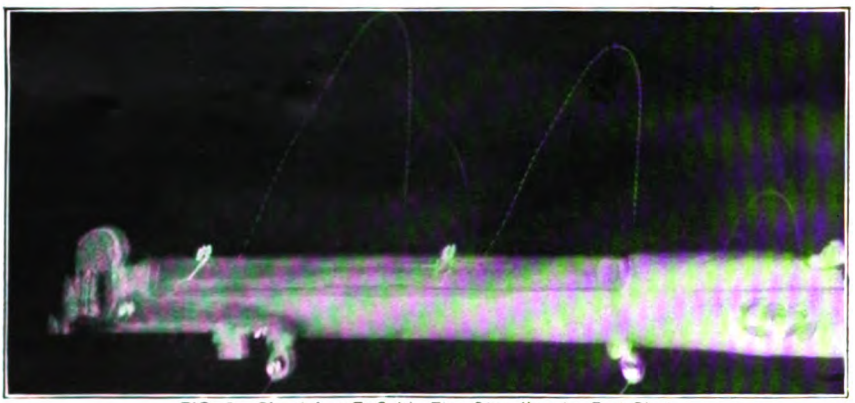

FIG. 3. Short Lee-Enfield—Fire Standing by Bad Shot.

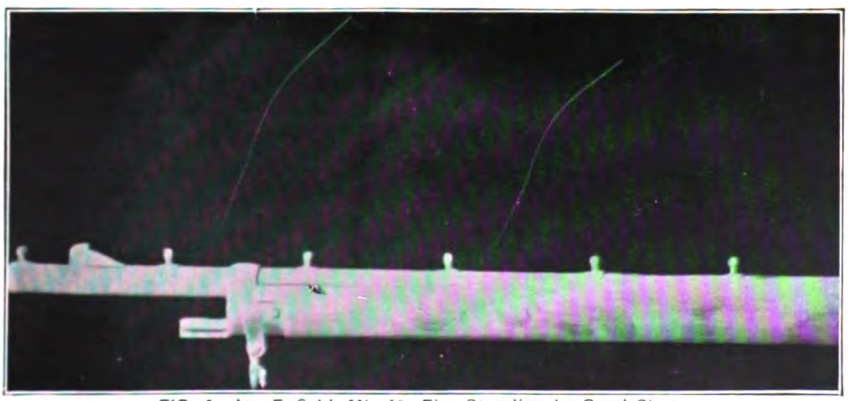

FIG. 4. Lee-Enfield, Mk. I*—Fire Standing by Good Shot.

NOTE.—The above are reproductions from untouched photographs.

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THE RECOIL OF SMALL ARMS.

By Lieut. F. V. Thompson, R.E.

Prefatory Note by Major C. F. Close, C.M.G., R.E.

In the year 1897, Major (now Lieut.-Colonel) C. B. Mayne, R.E., drew attention to a paper published in the *Journal of the United States Artillery*, Vol. IV., entitled "Note on a photographic method of determining the complete motion of a gun during recoil," and written by Dr. A. C. Crehore and Dr. G. O. Squier, U.S.A. The experiments described in this paper were of a rough-and-ready nature and no quantitative results were obtained, but they served to indicate the possibility of arriving at valuable information if more refined methods were adopted.

Accordingly, with the approval of the authorities, the writer of this note undertook a series of experiments which lasted for some weeks during 1897. Capt. (now Major) E. H. Hills, R.E., contributed much to the success of the experiments and lent a small motor and also a micrometer which was used for measuring the plates; the micrometer was again kindly lent for the 1904 experiments.

The 1897 experiments, which dealt with the Martini-Henry rifle, the Lee-Metford rifle and the Webley revolver, brought to light several previously unknown facts. The most important of these was the existence of vibratory movements of the rifle, materially affecting its shooting. The next was the determination of the maximum free velocity of recoil and the portion of this due to the rush of gas out of the barrel. Other interesting results were the exact paths and instantaneous velocities of recoil of rifles fired from the shoulder kneeling and standing, and the amount of rotation round a longitudinal axis. An account of these experiments was published in 1897 as No. 8 of the Confidential Series of the *Professional Papers of the Corps of Royal Engineers.*

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1904 EXPERIMENTS.

The following experiments were undertaken by the direction of the Commandant, S.M.E., with the sanction of the G.O.C. IVth Army Corps. The intention of the experiments was to determine the recoil velocity and barrel vibrations of the Lee-Enfield short rifle.

Before discussing results it will be as well to describe briefly the apparatus used.

DESCRIPTION OF APPARATUS.

The method consists in photographing the track described on recoil by luminous spots on silvered studs fixed to the rifle.

The luminous spots were images of the crater of the positive pole of a small arc lamp (requiring 40 volts and a current of 15 ampères) on the spherical surface of highly-polished silvered studs.

As the rigidity of the rifle was to be investigated, three or more studs were required and these were soldered on to the barrel of the rifle.

The weight of the studs was small, but was allowed for in making corrections.

So far we have the means of obtaining the form of the path along which any point of the rifle travels. To obtain the velocity of recoil at any instant a measure of time is necessary, and this is obtained by rotating a fenestrated disc (by means of a motor and secondary batteries) at known speed in front of the camera or light, so that light is cut off from the plate or studs (both methods were employed) at known intervals of time.

The disc most used in these experiments had 50 equal sectors, 25 open and 25 closed. It completed 1,000 revolutions in times varying from 80 to 90 seconds. A counting apparatus and stop-watch were used.

The disc thus gave exposures of about $\frac{1}{600}$ of a second, and the track of the studs appeared on the photographic plate as an interrupted line or series of dashes (see *Fig.* 1).

The plate was exposed about one second before the explosion took place.

By measuring the interval on the plate between successive exposures, knowing the scale, a measure of the velocity is obtained over a very small portion of the path described by the studs.

SOURCES OF ERROR.

In measuring velocities from photographic plates, the following are possible sources of error :—

1. Error in the counting apparatus of the rotating disc. This apparatus was tested and found correct.

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2. Error due to the light not being cut off instantaneously. This error was eliminated by so placing the disc that each sector had its edge horizontal as it crossed the optical axis of the lens. The lens was fitted with a narrow slit-shaped stop arranged horizontally and itself a sector of a circle.

3. Error due to change of rate of motor. This was found very constant.

4. Error due to inequality of dashes and spaces. This error was eliminated by making all measurements form the end of a dash to the similar end of the next dash to it.

5. Error due to the proper motion of the reflection of the light on the spherical surface of the stud. This error does not exceed three in a thousand; the correction was calculated and applied. The radius of the spherical stud used was 0·12 inches.

6. Error due to plate not being parallel to rifle. This is too small to need correction.

7. Errors in measurements. These were made with a micrometer reading to 0·001 m.m., and are obviously more accurate than at all necessary.

8. Errors in scale. This is merely a question of careful measurement of the distance between centres of studs.

9. Error due to weight of firing spring, string and silver studs. This weight was carefully ascertained and the necessary correction made.

FREE RECOIL.

Theoretically, if the rifle and ammunition are at rest and quite free to move, on the explosion of the charge, the momentum of the bullet and charge in one direction will be equal to that of the rifle in the other.

Hence, assuming that the gas is expanding uniformly at the instant the bullet leaves the bore and that the velocity of the bullet is 2,000 f.s., and all weights being known, it is found that the velocities of the Lee-Metford, Lee-Enfield, Mark I.* and Lee-Enfield Short Rifle are 7·2 f.s., 7·29 f.s. and 7·72 f.s. respectively at the instant the bullet leaves the bore.

This takes no account of the moving column of air in front of the bullet.

In practice, a near approximation of a rifle free to move is a rifle hung by a long fine wire, in which case the rifle is nearly free to move horizontally.

For this experiment therefore the rifle was hung horizontally by a wire about 12 feet long. To fire the rifle without affecting its movement, the following device was used :—The trigger was held back by a spring attached to the butt swivel; it was then pulled forward by a string and made fast; the string was burnt and the rifle thus fired without affecting the true velocity of recoil.

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The rotating disc as described was used to obtain a measure of the velocities.

The detail of the results of measurement of these plates is given below. The maximum velocity was measured from the track of each of three studs on each of the three plates, and a mean taken in each case.

Corrections were made for errors (5) and (9).

The rifle was fired without sling or bayonet and with magazine empty.

No. of Plate.	Interval in Seconds from Time of Explosion.	Maximum Measured Velocity in f.s.	Corrected Maximum Velocity.
52	$\frac{1}{100}$	9·70	9·910
78		9·85	10·06
79		9·75	9·960

Average maximum velocity, 9·98 f.s.

Thus the maximum free velocity of recoil of the Lee-Enfield Short Rifle with cordite ammunition is 9·98 f.s., and this is attained within $\frac{1}{100}$ of a second after explosion of the charge.

The maximum free velocity of the Lee-Metford Rifle measured by Major Close in 1897 was 9·3 f.s., and occurred within $\frac{1}{100}$ of a second after explosion of the charge. With black powder the velocity was 9·5 f.s.

The maximum velocity of free recoil of an ordinary 12-bore shot gun has been measured and found to be 17·3 f.s. with amberite.

Taking the maximum velocity of recoil of the Short Rifle with cordite ammunition as 9·98 f.s. and the weight as 8·5 lbs., the momentum* of recoil is 2·63.

Now it has been shewn that, neglecting the effect of the rush of gas out of the barrel and the disturbance of the air caused by it when the bullet has left, the velocity of recoil is 7·72 f.s. The difference (2·26 f.s.) multiplied by the mass of the rifle is the increase of momentum due to the rush of gas, and equals 0·59. Knowing the weight of the charge (31 grs.) it appears that the velocity of the centre of gravity of the issuing gas at the moment is about 4,300 f.s.

RECOIL AT THE SHOULDER.

Figs. 2, 3 and 4 shew the tracks of the studs when the rifle is fired at the shoulder standing.

* In calculating momentum of recoil, the formula $\frac{W \times v}{g}$ was used, where W = weight in lbs., v = velocity in f.s., $g = 32{\cdot}2$.

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From these and similar photographs it appears that the rifle recoils approximately in the line of the axis for about 0·5 inch.

During this space it is engaged in compressing the clothes and flesh and forcing back the shoulder of the firer, the resistance in this direction continually increasing and the velocity diminishing till the butt becomes nearly stationary; the remainder of the momentum is absorbed in a rotary movement about the shoulder due to the fact that the centre of gravity and the part of the butt in contact with the shoulder are below the axis of the barrel.

Fig. 3 shews where the bad shot "bobbed" before releasing the trigger and the large amount of error in his aim when the bullet left the bore.

FIG. 5.—Fire kneeling.

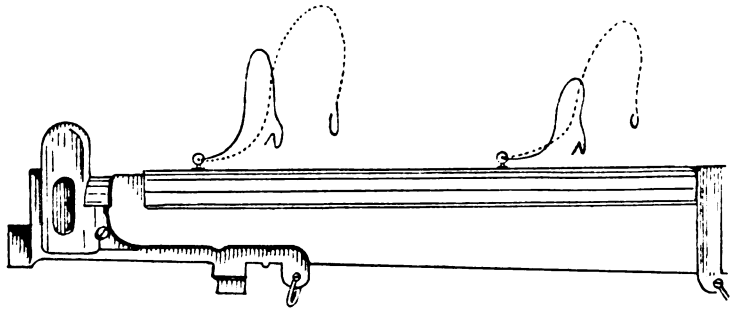
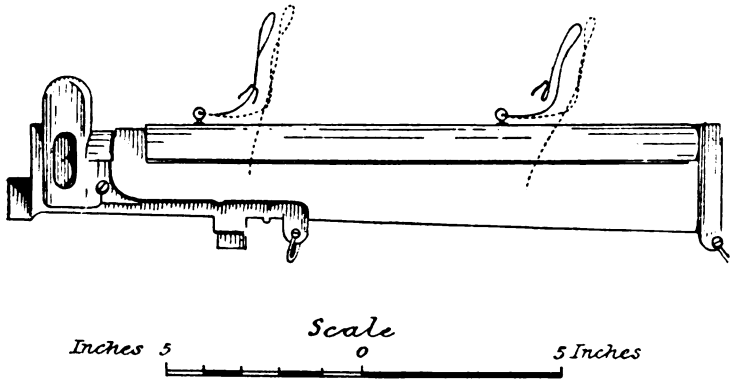


FIG. 6.—Fire lying down.



Good shot—continuous line.
Bad shot—dotted line.

Figs. 5 and 6 are accurate tracings of the tracks of the studs when the Short Rifle is fired at the shoulder kneeling and lying by good and bad shots.

The velocity of recoil at the shoulder depends on the tightness with which the rifle is held, and varies from 7 to 9 f.s.

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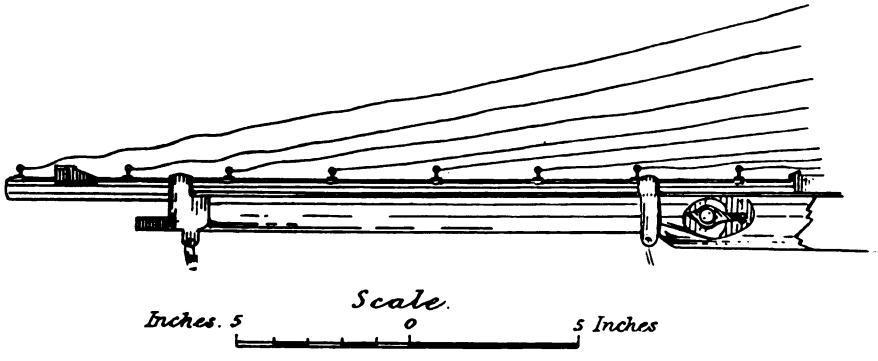
VERTICAL VIBRATIONS OF THE BARREL.

In the photos of free recoil it is found that the successive positions of the barrel are approximately parallel, so that the mean curve described by any point on the barrel is a simple one.

It is noticed however that the studs do not follow this curve but deviate from it in a series of small waves.

These waves are most noticeable at the muzzle, disappear at a point between the bands, and reappear again near the backsight (see *Fig.* 7, which is an accurate tracing of the paths described by studs on the Lee-Enfield Rifle).

FIG. 7.

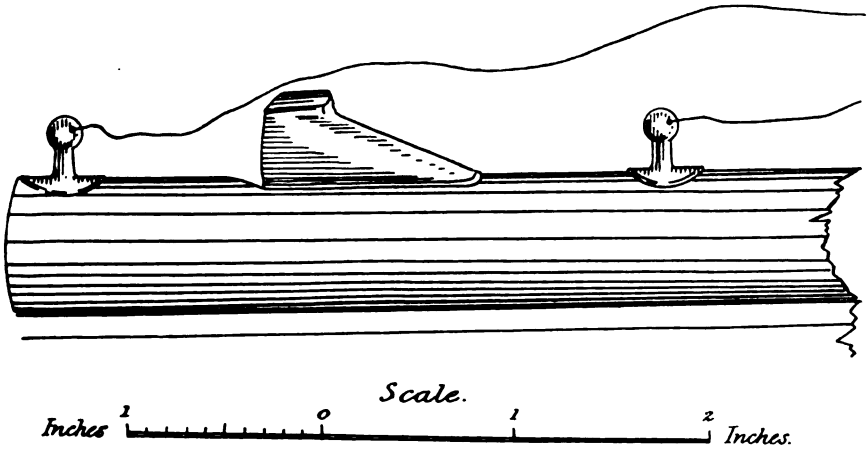


These waves in the tracks are obviously due to vibrations of the barrel on discharge, and from photographs taken full size (*Fig.* 8) it appears that there are two sets of vibrations in the Lee-Enfield Rifle :—

(1). The major vibrations seen in *Fig.* 7.

(2). The minor vibrations seen in the track of the front stud (*Fig.* 8). Any vibratory movement of the muzzle taking place at the instant

FIG. 8.



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the bullet leaves the bore will obviously affect the shooting. Vibrations after discharge will only affect the life of the rifle.

Now, the distances moved by the bullet and rifle whilst the bullet is in the bore should be inversely as their weight, so that when the bullet has reached the muzzle the Short Rifle has moved back 0·090 inch and the Lee-Enfield 0·103 inch.

In *Fig.* 8 it will be seen, on reference to the scale, that the Lee-Enfield muzzle, owing to the minor vibrations, has actually moved in a vertical direction during its recoil through this distance, so that any slight alterations in these vibrations will cause an alteration in the path of the bullet.

In this case of the Lee-Enfield the period of the major vibrations is about $\frac{1}{60}$ of a second and that of the minor vibrations about $\frac{1}{500}$ of a second.

The most important factor is obviously the amplitude and period of the minor vibrations, and their regularity would appear to depend upon :—

(1). Strength of charge.

(2). Uniformity of expansion of gas.

(3). Rigidity of barrel, governed by elasticity of steel, adjustment of bands and position of points of support.

(4). Uniformity of resistance offered by grooves to passage of bullet.

Since these are variable factors it would appear desirable in rifle construction to arrange that the secondary vibrations shall be as small as possible, and this condition is fairly well fulfilled in the case of the Lee-Enfield Short Rifle.

Figs. 9, 10 and 11 are tracings from photographs (full size) of the tracks of the front, centre and rear studs seen in *Fig.* 1 on the Lee-Enfield Short Rifle.

From these it would appear that the barrel in vibrating vertically forms a node near the centre stud and vibrates as shewn in *Fig.* 12, in which *c* represents the centre stud, *a* and *d* the front and rear ones.

The centre stud (*Fig.* 10) shews slight deviations. These were afterwards found to be due to the stud having worked itself loose. The node was accurately found in the case of the Lee-Enfield rifle (*Fig.* 7).

Fig. 13 shews the vibrations of a stud soldered to the foresight of the Short Rifle. The foresight being let into the barrel, the stud shews the vibrations of a point close to the muzzle and from this it appears that the minor vibrations are very small. This track presents a marked difference to that in *Fig.* 8.

On attaching a stud to the breech end of the barrel it was found that similar major vibrations existed there, and a stud fixed to the heel of the butt also shewed major vibrations ; neither gave a trace of minor vibrations. There is only one node formed.

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The period of the major vibrations of the Short Rifle are $\frac{1}{75}$ of a second and their amplitude 0·108 inch. The corresponding figures for the Lee-Enfield are $\frac{1}{60}$ second and 0·136 inch.

FIG. 9.

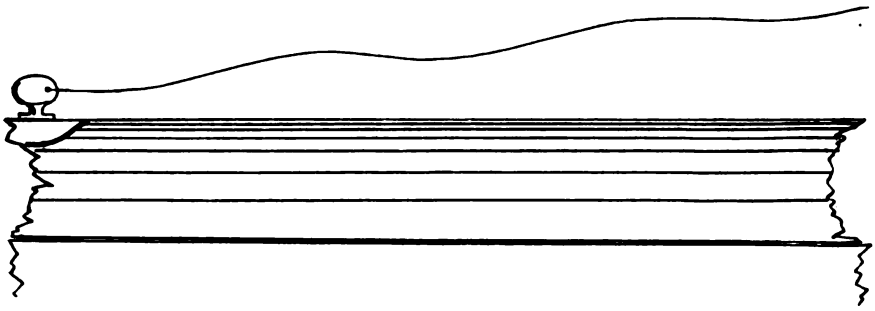


FIG. 10.

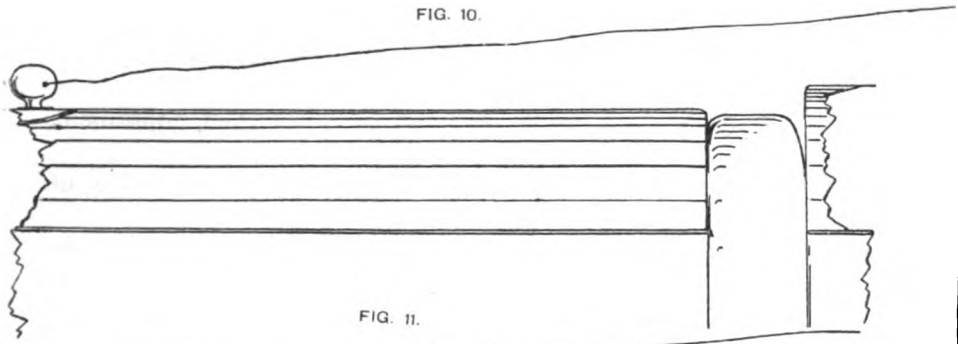
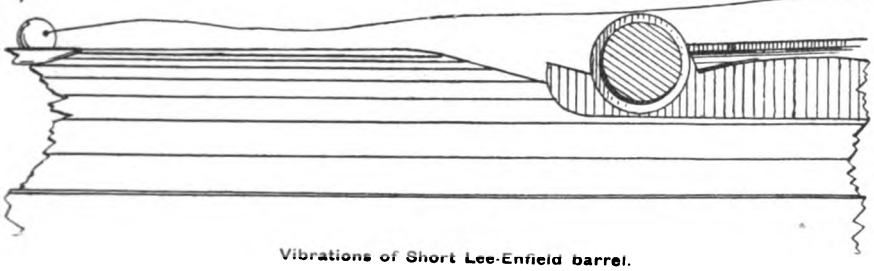


FIG. 11.



Vibrations of Short Lee-Enfield barrel.

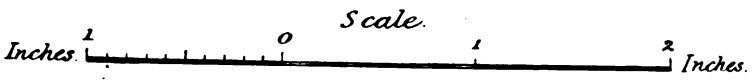
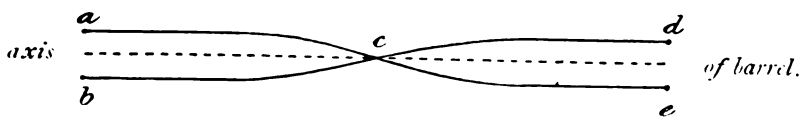


FIG. 12.



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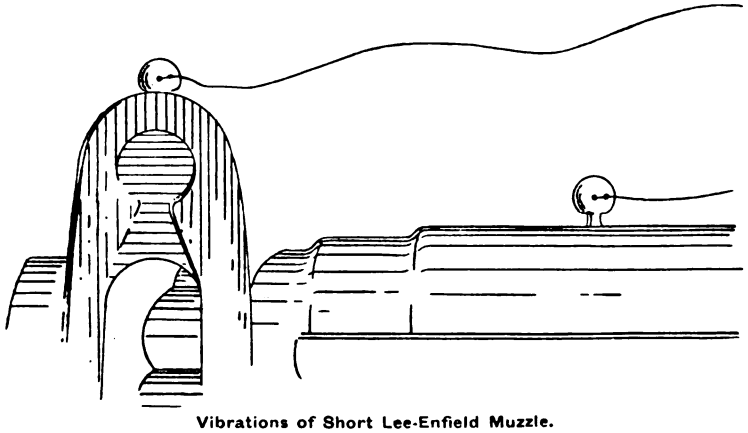
LATERAL VIBRATIONS OF THE BARREL.

So far only the vibrations in a vertical plane have been dealt with. To ascertain the amplitude of any existing lateral vibrations, a series of photographs was taken from a point vertically above the muzzle, some with the rifle free to recoil and others with the rifle fired from the shoulder.

From an examination of these photographs it was found that there were no appreciable lateral minor vibrations and only a very slight deviation corresponding with the major vibrations in period. Unfortunately the photographs were too indistinct to take measurements from.

FIG. 13.



Vibrations of Short Lee-Enfield Muzzle.

From this it seems that a projection on a plane perpendicular to the axis of the barrel of the actual path described by the muzzle partakes of the shape of an elongated ellipse whose major axis is vertical and has a maximum value of 0·108 inch in the case of the Short Rifle.

It will be noticed that in each case the first movement of the muzzle is an upward one and it is in the course of this movement that the bullet leaves the bore.

It was found that the direction of this first minor vibration was the same whether the rifle was at the shoulder or free to recoil.

From the pressure curve diagram (page 226, *Textbook of Small Arms*, 1904) it will be seen that a maximum pressure of about 16 tons per square inch is attained when the bullet is 6 inches from the breech. Evidently this small portion of the breech end is suddenly put into a high state of tension and dilatation. This

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state of stress may be imparted to the fore portion of the barrel in wave form more quickly than the bullet travels, thus setting up a minor vibration before the bullet has time to leave the muzzle.

It was thought that the upward movement in the first minor vibration might be due to a tendency to resist Bending Moment. This was found to be erroneous, as a photograph of the rifle fired when suspended from both ends, with a heavy weight placed near the backsight, shewed a vibration of similar direction. Also a photograph taken of the rifle turned through 90° about the axis of the barrel shewed very insignificant vibrations.

It was then thought that the rifling might influence the minor vibrations but it was found that a smooth bore gave similar vibrations. Probably the unsymmetrical shape of the rifle with respect to the axis of the barrel is solely responsible for the magnitude and initial direction of the vibrations.

SUMMARY OF RESULTS.

On explosion of the charge the rifle recoils at first in a nearly axial direction; during its motion it compresses the clothes and flesh of the firer, and after moving back about 0·5 inch it begins to rotate about the shoulder, the foresight describing an arc about 5 inches in length when fired in standing position.

The moment that the bullet has left the bore the powder gas rushes out with greatly increased velocity, the centre of gravity of the gas moving at a rate of not less than 4,300 feet a second.

The force of the blow of recoil absorbed by the firer is measured by the momentum of free recoil :—

i.	The Short Lee-Enfield has a momentum of	2·63
ii.	The Lee-Metford	2·61
iii.	An ordinary 12-bore shot gun	3·70

During the passage of the bullet along the barrel the rifle is subjected to varying strains, the maximum pressure occurring when the bullet is about 6 inches from the breech.

This state of tension or dilatation is communicated to the muzzle more quickly than the bullet travels, so that the bullet arrives at the muzzle when the latter is in a state of vibration, thus affecting the path of the bullet and the sighting of the rifle.

The direction of the vibrations is probably influenced by the unsymmetrical shape of the rifle with respect to the axis of the barrel, which prevents the recoil being taken up axially.

The projection of the path of a vibrating point near the muzzle on a plane perpendicular to the axis of the barrel may be considered to be an elongated ellipse, whose major axis is vertical and has a maximum length of 0·108 inch in the case of the Short Lee-Enfield, this length not being attained till after the bullet has left the bore.

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Superimposed on these are the minor vibrations.

As would be expected from its shorter barrel, the new Short Rifle has much smaller vibrations than the Lee-Enfield.

On account of the impossibility of ensuring absolute uniformity in the charge and the rate of explosion, and on account of the varying state of the bore, the vibrations themselves cannot be absolutely uniform, and, since they affect the shooting, the less a rifle vibrates the better.

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FIELD COMPANIES, R.E.

By COLONEL MARK S. BELL, V.C., LATE R.E.

IN December, 1897, the *Journal of the Royal United Service Institution* contained an article by me on the "Fourth Arm," in which I mentioned that there appeared to be no satisfactory exposition setting forth the duties and scope of action of Engineers in the modern battlefield in co-operation with Infantry, and stated my conviction that there is a *rôle* before the Fourth Arm in the fore-front of a battle as glorious as that which they enjoy when a siege is being actively pressed or a defence stubbornly conducted. I endeavoured to supply deficiencies in the then drill-books so far as the employment of Engineers in action was concerned, and made certain observations from which the next ten paragraphs are extracts.

"To gain information Engineer officers are required with the advanced Cavalry reconnaissance, and from this reconnaissance they should be able to foresee and arrange beforehand for rapidly fortifying important positions to be gained by the Infantry and for the passage of Cavalry and Artillery over partially destroyed bridges, etc. A few specialists will also be required with the advanced Cavalry to assist in destroying or re-forming communications, to tap and repair telegraphs, etc.

The bridging section must be well to the front; and the telegraph battalion must connect up the various sections of the battlefield with headquarters, and maintain this connection.

Obviously, therefore, the Engineer-in-Chief must be intimately acquainted with the plans of the General in command; and Commanding Royal Engineers, though they should frequently proceed to the front to ascertain what engineering works are required and to ensure the effective co-operation of the engineer arm, must constantly rejoin the headquarters of their units to keep touch with the views of their own Generals.

The company training of the Infantry must suffice to enable them to entrench themselves in the firing line, though Sappers may occasionally have to be pushed forward to assist in the defence of specially important points or the fortification of *points d'appui* to prevent a check degenerating into a rout.

The Engineers with offensive sections use their rifles when required to do so, and the Infantry soldier must also be taught

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that the entrenching tool is second only to the rifle in importance and that he must use one or the other as the exigencies of the fight may direct.

An attacking force must ever be ready to assume the defensive and to entrench themselves; the want of time to carry out this precept in manœuvres leads to a lack of reality and to a vicious training. The modern battlefield is a slow and weary wearing away of opposing forces; the advance can only be made step by step; and here comes in the increasingly important *rôle* of the Fourth Arm.

It is often essential that Engineer officers should take the initiative in carrying out their special field duties,—such as reconnaissances of positions, passages of rivers or swamps, preparations for defence, construction of bridges, re-establishment of communications—in order to aid in the development of a fight; but they must keep commanding officers informed of their work and its objects, and initiative must be duly subordinated to the aims of the chief.

The application of field works to tactics should be practised during manœuvres. All units should be accustomed to test the use of field entrenchments in various circumstances, in the firing line, in an extended 'holding' position, etc.; and staffs should be organised to give unity of action and effort. The training of Infantry on "field-work grounds" gives no idea of the application of works to tactical requirements; in all tactical exercises and manœuvres lines of entrenchment or redoubts might be represented by lines of implements and men at their digging posts. Time for construction of works in the field does not fail so often as the presence of tools and engineers at the right time and place.

A retirement gives ample scope for the action of the Fourth Arm, both independently and in co-operation with Infantry. Why not practise this in peace time, instead of employing our Field Engineers as Infantry or in arranging water supply of camps?

Paucity of numbers has led to the value of Engineers in the field being overlooked. Their numbers should be largely increased; and this might be best and also economically effected by adding to each artisan company one or more companies recruited from labourers, porters, navvies and miners and thoroughly trained in field duties. We might see a section of artisans working with a company of pioneers, one such section and one company at least to a brigade of Infantry."

During the succeeding year and the early part of 1899 a most useful discussion was carried on in the *R.E. Journal* on the organization and training of Field Companies; and at the end I wrote the following letter which, however, was not published.

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My final words on this subject, so important and ever vital to the Corps, may still be of interest. I still hold that the Engineers are a fourth tactical arm, and not the least important of the four, and that training and organization alone are required to establish this. I would also draw attention to the concluding paragraphs of my letter, referring to the duration of battles, and to the night work that must now-a-days complete the day work. I pretend to be no prophet; but I had endeavoured to keep my tactical knowledge on a level with that of soldiers of foresight, and had the conditions of modern battle been clearly understood and accepted by us and acted on in South Africa it might have been better for us.

The letter was written when I was still an officer of the Corps. Service conditions have since landed me on the rocks whence I can see nothing, and as I can only hear what is going on I propose to enter no further into the discussion of R.E. tactical duties. I did what I could in my day, and it is now for others to do what they can. What I hear I do not like, for I hear of the same folly of representing field works by tapes and flags; and this is as distasteful to me now as it was 30 years ago, when, occupying such an imaginary work, I refused to turn out of it, on being called upon to do so in half an hour, refusing also to consider my command as prisoners. I remember we compromised matters by both sides adjourning home to lunch. What folly it all was; neither of us had any tools, or any means of carrying them; nor, if we had had them, would we have used them even to the extent of marking the tasks of the men who had been supposed to construct them, and this was the very least that should have been required of us.

LETTER OF MARCH, 1899.

My object in drawing attention to the Fourth Arm was to indicate what work it is considered to be capable of doing, and ought to do, on the battle field in co-operation with Infantry in all stages of the attack and defence; that the important duties which fall to it can be best done by itself; and how unfitted it is by its present organization, training and numbers to efficiently perform them.

Incidentally, from the perusal of the paper on "The Fourth Arm" in the *R.U.S.I. Journal*, the attention of the R.E. Officer is drawn to the Field Company, which, it is maintained, is its mobile, tactical battle unit, and not a garrison or line-of-communication unit, except when not required for tactical purposes; and to carry out its mobile tactical duties it is supposed to be efficiently organized.

Extracts from a long paper are always unsatisfactory, and I fear that those who are interested must carefully read the article on the "Fourth Arm" for themselves. Therein is shown what

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work falls to Engineers and Infantry respectively; and how the Engineer numbers may be increased by raising, as an integral portion of the Corps, pioneer companies, to be brigaded with artizan companies, and recruited from miners, navvies, agricultural and dock labourers, etc. I might add that garrison and line-of-communication Engineers would naturally take up the duties of the Field Engineers where the latter left them off; that the Engineers have nothing to do with supplying Infantry with tools or with doing their spade work for them; that spade work ought to be a potent factor in the modern battle, but that whether it will be or not must be left for the future to decide. What is maintained is that the General who can utilize it as a potent factor will score greatly over the one who cannot; that to gain this advantage is certainly worth trying for; and that to use Engineers as transport or on communications, when their services as experts on tactical field works might gain or save the day, thoroughly disheartens and demoralizes all ranks and means fighting with the disadvantage of not using all the activities and resources available.

A bridge cannot be destroyed or restored, works executed, or positions strengthened without proper means and organization and co-operation of units, any more than a position can be shelled and occupied by Artillery without guns and co-operation of units; and the more thorough we are in manœuvres the better we are likely to do in war; and yet again we must use a little common sense and not tear a building to pieces to get at its timbers.

All the duties detailed as falling to the "Fourth Arm," and that it is desirable they should do to obtain the best results—and remember that the best results may mean victory, and lesser results a check—it is considered they can and should do when efficiently organized and trained. This organization requires not only proper inter-communication between the Chief Engineer (who is the mouthpiece of the General for all engineer services) and his subordinates, by one of whom he will possibly be best represented in the Cavalry reconnaissance, but also proper inter-communication within the Field Company, between its sections. The Company must have suitable numbers and a good organization into working sections and even squads, with a suitable proportion of men of various trades, for extending working parties and re-assembling, for issuing and re-packing tools, etc., etc.

In addition to the Field Engineers and Pioneers with brigades would be those with divisions and army corps, a company of the former and a wing of the latter (or more) with each, all trained to field and railway engineering.

The perplexity that may arise in the minds of some regarding the interlacing of duties is due to present want of organization and training; supply these wants, and to me the Engineers are all sufficient to perform all the duties of co-operation that legitimately fall to them and to perform them better than anyone else can

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for them. With a good chain of command and with the Engineers suitably represented on the Staff, there is, as pointed out in the article on the "Fourth Arm," little fear of work being done when the General does not contemplate it; but of one thing I think we may be pretty confident and that is, that the officer who, seeing an opportunity for employing his arm, awaits the written order of the Chief-of-the-Staff to co-operate will certainly not be judged to be the "right man in the right place" and will deserve to be roughly treated.

Action by intuition and an initiative subject to the aims of the General are essential to success; and the less we hear the better of such methods as that of the subaltern, who, when ordered to bridge a small stream in the hills of India, is said to have retired to the shade to work out strains and dimensions and to have found on his return that the bridge had been completed by a few practical men.

Success in war requires of us our very best of body, brain and moral,—no second best will gain it—,our best of effort, courage, self-sacrifice and co-operation to its attainment.

Every arm can best work out its own tactics. To the "Fourth Arm" this virgin duty now falls; and this can possibly be safely left to the rising generation of the Corps, to the captains and subalterns whose young, vigorous and impressionable minds will find in it a task worthy of their steel. Innovations will always be received with caution and many difficulties have to be overcome; but let us be practical, and solve them practically and not academically. To this end let us hope to see the Field Companies concentrated yearly in camps under selected R.E. Officers, working at tactical field work problems over haphazard country, gaining that eye for country which will alone enable them to adapt works to ground and to intuitively seize on points of advantage during an advance or retreat, etc.; all this without at the same time neglecting to render themselves efficient in all the practical constructional details of field engineering, and to elaborate a thoroughly efficient equipment and organization, etc. A training by half companies (to suit the convenience of the Works' Branch) on the field work grounds generally available cannot be called "field" training.

And now having said so much, I propose to say no more, except to recommend that we should endeavour to organize and train for what we ourselves feel confident we are capable of, and not for that to which others would limit us; not for a three-hour sham-fight to please the sightseer, which to us is worse than useless, tending to dishearten the men and to make them think themselves of no value in determining the issue of the battle that is raging around them; but for the modern battle, which, it is predicted, will last from one to three days and during which the work of the Engineer will not

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cease with nightfall, for he will have to take a chief part in strengthening positions already carried or those seized during the night as vantage ground whence to initiate the next day's encounter.

Finally let me express the opinion that we may sooner or later, and perhaps sooner than many expect, have to fight such battle or battles for empire; for empire can be lost by losses on land, by the loss of India, as well as by losses on sea.

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NOTES ON ENGINEERING WORK IN NORTHERN CHINA.

By Bt.-Colonel G. K. Scott-Moncrieff, c.i.e., R.E.

One of the first duties of the officer who has to undertake the direction of engineering matters in a campaign in a given part of the world is to decide what special tools or stores should be taken to suit the peculiarities of the country or climate. To a great extent provision has been made for this in the various Regulations and Lists of Equipment which have been compiled in our army from time to time, based upon the experience of war in countries differing so much from each other as the bare rocky highlands of the Afghan frontier and the desert stretches of the Soudan. Certain articles of equipment have in any case to be taken and about them there is no question; but the problem in the case of every expedition to a new country has to be viewed in the light of several considerations, the nature of the country and its natural resources, the capability or otherwise of the inhabitants to supply skilled labour, the probable obstacles to be overcome, and the possible tasks which the army may have to undertake.

All these points had to be weighed when we were preparing to start for China in 1900, in the few busy and hot days at Calcutta, when time was precious and information of our objective by no means defined. As the information of the resources of the people and the country was also scanty and not very accurate (as it turned out), it may possibly be of interest if I relate here what our forecast was, how far our arrangements suited the case, and what assistance one could rely on, both from the material resources of the country and the skill of the people.

It was understood that we had to operate in a flat country intersected with ditches, with many roads (which were, however, heavy for wheeled traffic), densely populated, but deficient in trees, and altogether wanting in all building material.

It was also understood that we had to force our way into an ancient city with great old-fashioned fortifications, surrounded by deeply sunk roads and by buildings which approached so near to the fortress that cover for attacking troops could easily be obtained prior to a rush or escalade. As regards accommodation for our troops, it was believed that the Chinese houses were either in themselves suitable or that they could be easily adapted, but that the supply of

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materials and the numbers obtainable of anything in the way of skilled artisans were few.

Further we were proceeding on the assumption that as regards railway or telegraph work, our business would be to repair partial damage, restore traffic, and then work the lines so renovated.

So far this was the general idea, and, like most general ideas in war, it turned out to be partly true and in many important respects wholly mistaken. The country is flat and the roads heavy for wheeled traffic, but, on the other hand, it is full of animals and carts which are accustomed to traverse those roads. (At first, however, we could get very few of these). There are trees in the neighbourhood of most of the villages, and in the important towns there are large supplies of timber. There are many boats, and the most skillful boatmen probably in the world.

All the information we had about Peking was in the main correct; but, as it turned out, the very size of the fortress proved its weakness, and the attack on one part enabled the advance on another to be unopposed and completely successful.

Our assumptions as to the railway and telegraph were utterly mistaken. Anything more thorough than the destruction of these important adjuncts to the advance of a modern army it would be hardly possible to imagine.

Finally our ideas of the skill and willingness of the natives were wholly and agreeably disappointed. About this I shall say more presently.

However of course first arrangements had to be made in Calcutta with the limited information then possessed.

As we might have to rebuild railway bridges or might have to construct a landing pier, arrangements were made for sufficient timber for three hundred yards of railway bridge work. As a matter of fact we found a very good wharf at our base, and also a good supply of timber in the country. But the material we brought with us was badly wanted at Wei-hai-wei, and so it was very usefully employed.

To destroy the Chinese defences we took two tons of dynamite in addition to the usual allowance of explosives laid down for an expedition. This dynamite for the most part lay buried during the winter at Peking. A small amount was expended in the demolition of Chinese defences in the Paoting-fu and other expeditions, but the greater part was most usefully employed in the spring in clearing sunken junks in the Peiho river between Tientsin and the sea. Seventeen wrecks were thus removed, and this not only gave good practice to our sappers, but it did a valuable service to the commercial community in clearing away obstacles to navigation.

For scaling ladders, field observatories, and a variety of other purposes which might arise in the attack of a position such as that which we expected at Peking, the biggest and strongest bamboos in

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Hong Kong were purchased. As a matter of subsequent experience we found that, although we purchased every bamboo of sufficient length and quality that the Hong Kong market could produce, to the number of about two thousand, this number was far below our requirements. Of all the trees in the forest the bamboo is the most useful to the military engineer, though little required for permanent works by the builder. Of it we made roofs, ladders, screen walls, bridges, telegraph poles and a number of other things. Its toughness and light weight make it a particularly useful article.

To connect our landing stage with our camp, which might be situated at a distance from the shore, I ordered, at the General's suggestion, five miles of light tramway, with a number of wagons. This was not required at first; but when Shan-hai-kwan was occupied, it was sent there and put down. I think it is right to say that we lent this line to our Allies and placed a certain amount of our rolling stock freely at their disposal, and they used it to a very great extent. I do not know that in any case we were allowed the use of any of their special equipment; but at all events none can say that we treated our Allies in an ungenerous manner, for this was only one out of several cases where we either lent them stores or else waived our unquestionable claim to rights won by our troops.

Besides the above we took with us barbed wire, cordage and a few other things in excess of the usual scale, in view of the requirements of detached defensible posts or the construction of bridges.

Most of the above stores were ultimately of use, although, as will be readily understood from the above, the actual employment of them was not under the conditions which were at first anticipated.

One question which was referred to me was the taking of a pontoon train. On the whole I concluded that it would not be required and I am glad that this view was not falsified by later events. In a country intersected by creeks, no doubt a pontoon train would be useful, but it would take up a lot of room in a ship and involve the transport and feeding of many men and animals, besides which it would be itself difficult to drag about in a sticky country. On the other hand where there are rivers and creeks there are boats and ropes, and with the aid of poles and lashings bridges could surely be extemporised. This proved to be fairly correct.

One of our first tasks at Tientsin was to extemporise a floating bridge out of the junks used in the river traffic, and, although it was not of course so good as a regular pontoon train, it served its purpose well enough. The Chinese junk is peculiarly well adapted for floating bridges. It is indeed very much like our service pontoon in shape, and the smaller junks or sampans are arranged so that they can be made longer or shorter by being fastened together longitudinally, just as in our more recent pattern of pontoon. Then they are built in compartments, and are fitted with anchors and steering gear, very

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ingenious, easily repaired, light, and well adapted for the various uses to which they are put. Hence the necessity for European-made pontoons really never arose. The Germans brought out some of their pontoons, which they used in the construction of a bridge at Hanku; it was a good bridge, but it was not any better than one made up of junks would be. I believe a pontoon train was taken to China by our army in 1860. I saw it at Hong Kong where it has been ever since; and, although I had some doubts in my mind as to whether it would be advisable to use it again, I concluded that it would be unnecessary and that opinion I still hold.

The Chinese are wonderfully skilful mechanics, but their labour is much in need of scientific direction. This no doubt arises from the fact that all application of labour to practical purposes is looked down upon by the educated classes. Thus the whole of their building work is in the hands of uneducated men, and the result is great waste of material and labour. The quaint carved roofs, with which pictures have made us so familiar, are very pleasing in design; but the quantity of timber used in their construction is enormously in excess of requirements, and, although great practical skill is shown in the way the various parts are put together, it is evident at a glance that no scientific unity exists between those parts. Again, as no Chinaman trusts the walls of a house to carry the weight of the roof, it is evident that the height of his house is limited by the length of the wooden pillars he can obtain. A double-storied house is therefore uncommon, while a house of more than two stories does not exist in any part of a Chinese town. The floors of the upper stories are as weak, relatively, as the roofs are strong, and even a single person walking across the room causes the whole to vibrate.

The Chinese are exceedingly clever sawyers and carpenters. Their tools in many cases are very ingenious and a very great improvement on ours. This remark also applies to much of their fittings on board the junks, which combine simplicity and cheapness with thorough efficiency. Space does not permit me to describe any of these tools and appliances in detail; are they not written in official chronicles?

They are also singularly good at copying any foreign production. At Tientsin I wanted to buy some cooking ranges for kitchens, but the price of them in the European shops was very high. A Chinaman produced a copy so exact that it had not only all the essential parts but the very name of the patentee cast upon it. I did not buy it, however, although the price asked was about one-third of the other.

But in building walls the Chinaman fails. His idea of a wall consists of two outer thin skins of brick or stone, filled up with any rubbish between. Many of the walls in Peking are built with only the outside of brick, and clay rammed in layers inside. Such a wall is frequently sixteen to eighteen feet high, and about six or eight feet thick; it requires a regular roof of tiles to keep the rain from

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washing away the clay inside! The bricks of the country are small, about one-half the size of an English brick, always of the same slate grey colour, but well shaped, well burnt and apparently durable. The old walls in cities are built of huge grey bricks, three or four times as big as our bricks, wonderfully well made. I do not think, however, that any of these are made nowadays. For mortar the natives use a very white lime, which they mix, contrary to all our rules, with a sandy earth; this makes a marvellously hard mortar. They also make concrete of broken brick with the white lime and clay, mix it dry and ram it as tight as heavy stone rammers can pound, and then sprinkle water over it. I insisted upon their making concrete in our fashion; of course they obeyed orders, but did so with a shrug of the shoulders, disclaiming all responsibility. Some of the old concrete in the Tartar City Wall in Peking is as good as any I ever saw.

An engineer of long experience in China told me he had tried again and again to instruct the bricklayers in the mysteries of *bond*. He said he had given it up after many attempts as hopeless. In my case I generally made the Sappers build a small portion as a sample and insisted upon the Chinese copying it, which they generally did—as long as my back was not turned.

During the early days at Peking we had a hard time with our Chinese labour. At first few of them came to us, and few had sufficient confidence to take up contracts or piece work. When however they found that we looked after them, gave them regular pay, and, beyond making them work, left them otherwise alone, they came freely enough; and soon, both there and at Tientsin, I learnt to appreciate the very valuable qualities of the Chinese contractor. A respectable Chinaman is an admirable man of business, and as an enterprising contractor I never met anybody like him. The work they do is extraordinarily cheap, and the way they organise and subdivide their labour is most instructive. We paid not only far less for the work than we should have done in England—that of course was only to be expected—but considerably less than we should do in India, which I was most surprised to find.

Our usual method, when a particular work had to be done, was to assemble three or four contractors together and explain fully the work required, and whether we proposed to provide the materials or not, and any similar conditions. Then we set the men apart from one another, and asked each separately what he would do the job for and how soon. Generally the replies did not vary much from each other, and usually the lowest tender was taken. From the nature of the work, we knew what it would have cost in India, so that enabled us to know whether the offers were exorbitant. I have often wondered how on earth they could do it for the money they asked. But they did it well and seemed to make a fair profit.

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On one occasion I wanted to build certain quarters for railway employés in a great hurry. The weather was bad, snow was lying deep on the ground, and the country roads all but impassable, while the Chinese artisan could hardly be persuaded to face the severity of the elements. I went with Major F. V. Jeffreys, R.E. (who spoke Chinese) to the place, accompanied by three contractors, respectable men who had already done a good deal of work for us. We explained the work to them, and then, sending them away to three different spots a little distance apart from one another, we consulted together and made a rough estimate of the cost, based upon measurements which we made and upon an exceedingly low unit price. Then we went to each man, who had been standing vacantly staring in front and apparently much bored by the whole proceedings, and asked for his tender. To my astonishment each man's estimate was within 4 per cent. of our calculation. We gave the lowest tenderer a contract to do the work in a fortnight, which I thought was driving a very hard bargain. He finished it in ten days.

After such an interview as that which I have described we made out a written contract in Chinese and English. I believe this really to have been unnecessary. The contractors always stuck to their word, and were most obliging in the matter of minor alterations. But I think one essential point lay in using Chinese (*i.e.*, non-European) interpreters as little as possible. With a Chinese-speaking Englishman one got on far better with them than with an English-speaking Chinaman. This fact came before me one day at Peking in a very prominent manner. I wanted to make a bargain with a man for some road metal, delivered at certain places. I went round with him, told him as well as I could what amount he was to bring and what price he was to get (we each knew a few words of the other's language, and signs did the rest), and he seemed quite satisfied. I then went back with him to my quarters, and it happened that on the way I met a Chinaman who was employed by us as an interpreter. He and the contractor talked with one another while I wrote out the conditions of our bargain. I then gave it to the interpreter who read it in Chinese. When he was done, he said "But, sir, this man not sign. He say too little." And nothing would induce the contractor to stick to our bargain. Evidently the interpreter had arranged to have his "squeeze."

I am aware that the satisfactory opinion I have of these Chinese contractors is different to the experience of some well-known residents in the country. I only give my opinion for what it is worth, based of course upon a very slight acquaintance with the people. Possibly also the fact that the men I speak of came mostly from Tientsin, and were therefore accustomed to dealing with Europeans, may have had something to do with their business qualities.

Chinese labourers are very clever at moving heavy weights. Little

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mechanical devices—many of them very ingenious—are common among the working class, and they understand how to work in unison so as to apply their united labour to the best advantage. All the work of shifting and lifting heavy articles—such as is called in the Artillery "repository drill"—is done by them marvellously well; and it is clearly possible to train them to be skilful engine drivers and fitters. After we took over the railway, the greater part of the engine driving was done by natives, who not only did the ordinary work well but on one occasion at least behaved with extraordinary presence of mind and courage.

I think it would be possible to raise most useful and efficient companies of Sappers out of the Chinese. I believe they would take to the work very readily, and would turn out first-rate men. There are Chinese Sappers already at Hong Kong, but these are chiefly boatmen enlisted for submarine mining.

To sum up, any engineer proceeding to North China will find in the people and in the resources of the country ample material to his hand. They are clever mechanics, most hardworking, patient and willing, but they require guidance and supervision. They have little skill in brickwork or mason's work, but they can be taught almost anything, and they have not a little natural aptitude for such work.

The houses of the Chinese are generally built on one plan, which, as far as I could see, was the same whether built for the Emperor or for a village farmer. They consist of a series of courtyards, leading into one another by labyrinthine passages of the most bewildering description. In the case of the rich and noble the court is paved, and has possibly a garden or rockery, or tanks for goldfish, in the centre. On three sides of this yard there are houses, each consisting of three rooms, and with the floors (in the case of all but the poorest) raised some little way above the ground and approached by a broad flight of steps. The entrance to each house is in the centre, to the sitting room. On either side of it doors or screens lead into bedrooms, which are usually fitted with a raised "kang" or platform with flues beneath, which in winter are heated. This method of heating resembles the hypocausts constructed by the ancient Romans, and the method of constructing the flues is much the same as we find in ancient Roman villas.

The Chinese also have portable earthenware stoves for burning charcoal, but they have no fireplaces of our pattern, nor do they apparently employ fixed stoves. There is little difficulty however in building open fireplaces and chimneys in Chinese houses, or in fixing stoves. We did this to a large extent in all the quarters occupied by us during the winter.

The method of building their houses in a series of squares, opening into one another, has certainly the great advantage of privacy. As

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most of the dwellings, even of the rich, are single storied, it is impossible for one person to see what his neighbours are doing, and thus the Chinaman's house is his castle to an extent the Englishman's seldom is. Those streets of a town, such as Peking, which are not used for shops consist simply of two lines of grey brick walls with doors at intervals, the doors being sometimes ornamented by carved lintels or bright painting and frequently adorned with pictures of hideous tutelary gods. These doors are almost invariably shut, but even if open we should have no glimpse of anything beyond, as the view inside is always obstructed by a screen, the idea being that evil spirits can only move in straight lines and that a screen across the entrance to a house absolutely bars their further progress.

If we were to go inside we should usually find the outer courtyard containing common and indifferently ornate dwellings, probably such as would be used by menials or only fit for stables. A passage in some corner, always winding so as to avoid the straight lines, will take us into another court, and possibly out of this we go into a third or a fourth, the innermost ones being generally the most select.

The effect in the streets is deadly monotony. No windows open on the street, all houses in it are exactly alike ; and if, as sometimes happens, there are side streets or alleys leading out of it, the bewilderment as to where one is to get out becomes most exasperating. Even those who have a fairly good "bump of locality" will lose their way under such circumstances.

The buildings of the nobility are slightly different from the above in respect of general arrangement, though they also adhere to the method of squares. There is usually an imposing gateway with a green-tiled roof, and a flight of steps flanked by two marble lions (this animal is not really like a lion, it resembles most a pug-dog, but it is conventionally called a lion). Inside the gateway there is usually a large open court with menials' houses round. These houses in the case of the Chang-Wang-Fu at Peking afforded stabling to about 150 horses. Then there is a large open pavilion, usually approached up a flight of steps, leading into another courtyard which also has an open pavilion at the far end. I understand that in such pavilions the host meets his guest, and exchanges compliments or does any public business. At the sides of these courtyards there are smaller buildings, sometimes two storied. Those at the Chang-Wang-Fu appeared to be used as granaries. Behind these side buildings come the private apartments in successive squares, generally leading out of one another and frequently opening into gardens and pleasure grounds further on, but all surrounded by high walls so as to ensure privacy.

It will be readily understood how a set of buildings such as that described above lent itself to military occupation. The large open

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spaces near the entrance were suited for the stabling of horses, the inner pavilions for gun-parks, harness, forage and other store rooms, the side buildings for barracks and recreation rooms, and the small squares for officers' quarters. The Chang-Wang-Fu, for instance, made an almost ideal barrack for a battery of artillery, everything that the men usually have in cantonments being there, not perhaps quite as usual, but at all events in all essential points complete.

Thus the large courts are only used for public functions, the real social and domestic life going on the while in the small squares.

The rooms opening on these domestic portions are often most beautifully and tastefully ornamented. With us a door or a window is almost always oblong in shape, though sometimes with an arched or pointed top. In a Chinese house no such monotony of shape is permissible. The openings may be round or hexagonal or any other quaint shape imaginable. At the Winter Palace I counted in one wall thirty-two windows, every one of which had a special shape, the general effect being very pleasing. Again, the glass in the windows is rarely uniform, it is very frequently broken up into a maze of patterns like the proverbial "Chinese puzzle." Sometimes the screens separating one room from another are of wood carved with exquisite skill. In one house, occupied by some Japanese officers in the north of Peking, the whole of one such partition was carved in the semblance of a bamboo forest, each branch and the leaves being wholly distinct and complete. In one part the leaves and twigs were intertwined so as to leave an opening, circular in shape, for passage through the screen, the whole design being most beautiful. The most ordinary way of exhibiting this wood carving is under the main beams of the roof, two or three of which divide the ceiling into equal parts. From these beams, and vertically down the side walls, there appears to be what might at a little distance be mistaken for a curtain, caught up by a band at the angle between wall and ceiling ; but on closer inspection we find that it is all made of wood, carved into leaves and twigs and frequently with birds and squirrels here and there among the branches. No doubt the general idea of this was taken from a curtain made of silk or other fabric. In the room in the Winter Palace used by Field Marshal Count von Waldersee as a reception room, there were two or three of these beautiful curtains of wood, each representing some different plant, *i.e.*, one bamboo, one black-thorn, etc. It is sad to think that all the art treasures of that splendid room were swept away in the fatal fire of April 17th when poor General von Schwarzhoff lost his life.

In the country villages the houses are much better built and are fitted with more civilised accessories than the dwellings of the same class in India. Although in Chinese towns filth and squalor of the most disgusting sort prove the constantly-heard accusation of the want of cleanliness of the people, the country villages are much less

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offensive in this respect, and they compare most favourably with Indian villages. Indeed there is little that offends the eye or the nose in the rural village, because all noxious substances are made use of in agriculture, as they ought to be everywhere. Round all the villages are neat vegetable gardens, carefully laid out, well watered and evidently tended with scrupulous care. The wells for these gardens are numerous; they are usually lined with brick and have the mouth raised sufficiently far above the ground level to prevent surface water from flowing in. The water from these wells is cool and sweet; it was very largely used by the troops of all nations, and so far as I know there were no ill effects.

In the larger villages there are always some houses, built on the principle of squares, of a better class than the average, and in these houses many articles of comfort and refinement are in common use; so that a European will find himself far less uncomfortable there than he would in the best native houses in an Indian village, with its bad sanitation, dirt, and want of furniture. All the way along the Lines of Communication between Tientsin and Peking our officers lived very comfortably during the whole winter in Chinese houses, and obtained much furniture and crockery, etc., from the adjacent villages. I lived during the winter of 1879–80 in an Afghan house, but it needed a great deal of alteration to make it reasonably comfortable and I had no other furniture than that which I brought.

In the towns and large villages one of the chief institutions is the pawn shop, recognisable by the fact that it is surrounded by very high walls. The rural pawn shop occupies in a Chinese town the place that a branch of a bank occupies in an English town; for besides being a place where loans can be negotiated, it is a useful place of security wherein to put one's property during a temporary absence. I visited one of these at a walled town called Wu-chien-tsien, not far from Lofa station on the railway, one day in November. I was accompanied by some of the head men of the town; they had come to meet my companion, a cavalry officer, who had done them some service in protecting them and to whom they professed great obligation. I asked them if I might see over one of the two principal pawn shops, to which they readily consented. We first entered a sort of counting house, where a number of clerks were busy transacting affairs with clients across a counter, very much like a country bank. Behind the counting house was a large warehouse, in which were collected and labelled all sorts of miscellaneous articles, clothes, agricultural implements, books, etc., behind this again was another large warehouse, divided up with racks, and packed from floor to ceiling with chests and leather trunks. I asked if I might see the contents of a few of these, and my wish was at once complied with. Garments of every sort and colour, both for men and women, rolls of silk, embroidered jackets, fur-lined coats appeared to fill the boxes

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almost to overflowing. Everything was orderly and methodical and apparently well taken care of.

The high wall surrounding these pawn shops has often an elevated platform a little below its summit, so that a watchman stationed there can see what is going on. In the occupation and defence of various villages these pawn shops are thus most important, as they are ready-made keeps forming the centre or nucleus of the defence. In our advance on Peking the Japanese had the advantage of the rest of the Allies in knowing the value of the pawn shops, both in respect of the contents and the arrangement of the buildings, and when a village was occupied the crafty little men always made for the pawn shop. After these buildings the next in importance are the temples, usually substantially built and roomy. They are frequently on the outskirts of the villages and come in usefully in the outer defensive line. Sometimes detached farms were suitably placed, and we utilised these also as outposts connected with the main line of the works.

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THE FUTURE OF LONDON.

By LIEUT.-COLONEL J. WINN, LATE R.E.

IN the *R.E. Journal* of November last we saw that the future of Egypt depended very largely on the construction of the necessary dams and collateral works for the control of the Nile. Looking nearer home it is interesting to see that the future of London (as a port) depends upon re-modelling the Thames, so that it may be accessible for large vessels; and the construction of a dam below London (at Gravesend) appears to be the cheapest, and in many ways the best, solution of a question which has already reached a very acute stage.

Of course there are objections to this scheme—as there are to all others—and it may be useful to consider the disadvantages as well as the advantages over other proposals.

By the Port of London Bill it is proposed to purchase the docks, in opposition to the dock companies' wishes, and to dredge the Thames to a depth required by modern steamships. This dredging is acknowledged to be practicably impossible, owing to the tunnels under the river and for other reasons, the chief of which is that dredging will alter the slope of the bed of the river and the dredged portion will be filled up by material from the foreshores, thus endangering the river banks and walls; and the scheme will cost £38,000,000. Yet the London County Council seems wedded to it, and has recently rejected an amendment by which the Thames Barrage Scheme was proposed as an alternative, as being practicable, better in itself, and costing far less than the huge sum with which the L.C.C. so lightly suggest burdening the ratepayers. To purchase the docks without dredging the channel will be of no use, and it is to be hoped that the scheme will be abandoned.

The Barrage Scheme, by which the river from Gravesend to Teddington will be converted into a lake with a very gentle current running through it, offers the following advantages:—

A permanent navigable depth of at least 30 ft. up to London Bridge (without the necessity of dredging); so that vessels of large draught can pass up or down at any hour of the day or night.

The dock gates can be left open continuously.

The river navigation will be safer.

There will be no flooding between Teddington and Gravesend.

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Fixed piers, close to the shore, can be used for a paying steamboat service.

The river will be much purer, with no foul mud banks.

Ample water for the future supply of London can be provided without further capital outlay.

The dues and costs in rail and docks can be reduced by reason of greatly increased facilities and saving of the present time—losses in waiting tide, etc., etc.

All the river frontage lands can be brought into use with an immense increase of business.

There will be no need to purchase the docks, which can conduct a successful business if this scheme is carried out; and the upper docks will be rendered capable of full work again.

In addition to these advantages it is proposed to have a railway subway through the base of the barrage, which will connect up the railway systems on either side of the river, and also a roadway above it, thus forming a link between north and south which has for a long time been considered of the greatest necessity by the military authorities.

In view of the above a short description of what is proposed in the scheme originated by Mr. T. M. Barber, M.Inst.C.E., and Mr. James Casey, M.I.N.A., will be of interest.

In brief, it is a barrage, of mass concrete with granite facing, from Gravesend to Tilbury, with four locks in the centre. The provision of internal gates in addition to the outer ones will allow the locks to be worked in long or short lengths to suit the traffic; the lengths arranged in this way being 300 ft., 500 ft., 700 ft. and 1,000 ft., and the widths 80 ft. and 100 ft.

The barrage will be provided with the necessary sluices (much as in the Assuan dam) with a pilot tower in the centre.

The tunnel mentioned above will have a grade of 1 in 50, and pass through the centre of the foundations, which will be carried down to the chalk under the Thames ballast bed of the river. The height of the dam will be about 100 ft. from foundation.

As regards construction it is proposed to form a cofferdam round the site of the locks, and build them first; and when they are ready, to complete the weirs and sluices on either side to the shores.

The locks will be worked electrically from a power-house on the central pier of the locks, the power being obtained from dynamos operated by the fall of part of the water flowing over the dam. The sluices will also be worked electrically.

Such in a word is the scheme, the estimated cost of which is £3,658,000. A toll of ¾d. a ton on the shipping passing up and down will pay the interest on this sum; and will be amply compensated for by the reduction in river and dock dues, effected by savings in dredging, in operating dock gates, in time, in barging, in

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management of the river, etc., estimated at over £800,000 per annum and costing over 6d. a ton to the 30,000,000 tons of shipping entering and leaving the port.

The first objection that suggests itself is the sewage question. But it has been firmly established that fresh water has the power of oxidizing sewage effluents better than salt, and there will be no tide to bring back the sewage as at the present time, when, as has been shewn, the sewage is kept in circulation in the Thames for 45 days.

The effluent at Barking and Crosshaven only contains seven grains per gallon, and there is no doubt that the lightly flowing river (always in the same direction) will absorb sufficient oxygen from the air to thoroughly oxidize this amount. At the worst period of the year there will be 560,000,000 gallons of fresh water entering this lake from Teddington to Gravesend; the sewage effluent amounts to 150,000,000 per diem; and as the river absorbs an immense amount of oxygen on its passage from London to Gravesend there will be an ample margin. In this connection Mr. Dibdin's book on the *Purification of Sewage and Water* should be studied.

But some special arrangements will have to be made to deal with the storm water of London, as many of the present outfalls are only effective at low water. If the level of the river is to be permanently raised, it will be necessary either to convey all the storm water to the outfalls at Barking and Crossness, which would probably cost some £3,000,000 as the drains would have to be large, or to have large reservoirs into which the storm water could pass, and from which it could be pumped into the river above high water. At present many low-lying districts are flooded after heavy rain, as the storm outfall can only act at low tide, and if the necessary pumping stations were installed London would be relieved of this nuisance for ever.

The barrage will prevent the flooding due to high tides.

However there will still remain some low-lying lands in Kent and Essex, which will have to be drained by means of pumping stations; but when these are once at work all the land, now useless, will be rendered valuable for factories, etc., with riverside frontages.

It has been suggested that many of the present river banks, though doing good service now, would not withstand a permanent high level of water without percolation into the districts they protect. This is open to question, and such banks would certainly be more liable to subsidence if the existing bed of the river were lowered by dredging, as is proposed in the Port of London Bill.

With regard to the effects *below* the barrage, it has been argued that when the tide is prevented from running up to Teddington it will rise higher at Gravesend; but this is a misconception, and the effect of the obstacle at Gravesend would be rather to lower the height of the tide there and also to silt up the bed to a certain extent.

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It is proposed to overcome this latter drawback by scour sluices, provided in the dam, to be opened as occasion requires.

Another objection, which has been raised, is that delays will occur at the locks; but this will not be so great as those due to the necessity of waiting for the tide at Gravesend, and the amount of lock accommodation provided is based on the requirements of the known traffic, which could be considerably increased without exceeding the capabilities of the locks to deal with it.

The large number of barges now on the Thames depend upon the tides for their motive power, and their interests will be affected by the Barrage scheme. But in this connection it must be remembered that for 12 out of the 24 hours a very large number have to be idle whilst the tide is against them.

Towage will have to be resorted to. But as tugs can handle large fleets of barges, and towing is already being increasingly used, and in the dock-ised river barges will be able to approach any wharf, dock or vessel without waiting for tides, it is expected that the time thus saved—and time is money—will compensate for the loss of the tidal power to move the barges as at present, and that the new requirements of towage will soon adjust themselves.

Further criticisms of a minor character have been offered to the scheme, but its advantages seem to outweigh the claims of any other.

From a military point of view there are no objections, rather the reverse; from an engineering point there are no insuperable difficulties; from a commercial point it seems vital to London that something should be done—and that soon. Though a few minor interests may be affected, the proposal as a whole seems to meet the requirements of the case, so we may look forward at no very distant date to see the Great Thames Barrage.

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THE CHOICE OF A SMALL MOTOR CAR.

By Lieut. O. G. Brandon, R.E.

In the *R.E. Journal* of November last the results of recent small car trials were given with a view to their being of assistance to anyone contemplating the purchase of a car. That these trials are excellent in many ways there is no doubt, but their results must not be taken too seriously by intending purchasers.

In the first place there is nothing to show that a car entered in these trials is the average turn-out of that particular make, nothing beyond the name and reputation of the manufacturers; and though one can almost with certainty say that a car of one particular make is an average car, it is equally open to doubt whether, in the case of a certain other make, more time and care has not been spent on the particular car exhibited than is given to the average car.

Then there is the question of "tuning up." Every car when first put on the road requires a certain amount of adjustment until the various parts get into good running order: the number and nature of these adjustments vary, they may be simple or the reverse, adjustable by almost a novice or requiring the skill of an expert. On this subject the trials referred to do not enlighten us, but it is of considerable interest to those who are trying to decide what car will suit them best.

Again, one car may do just as well as another in the trials, and yet from the materials used and the method of construction the life of the one may be only half that of the other.

We may assume that the intending purchaser will go round to all his friends who own cars and ask their advice. Unhappy man, for what a variety of opinions he will get, leaving him only the more bewildered.

What I would advise is this;—See if you have among your friends one who has a good knowledge of cars in general, especially of those of other makes than his own. If so, go to him; and having got his advice on perhaps two or three makes, go round to the makers and try their cars. All makers are only too pleased to take you for a trial run, and then you can judge for yourself the respective running merits of their cars.

If you cannot get more or less expert advice then I would say;—Buy a car of known good make and repute; you may pay a little more for it than for another car that you think might suit you, but at

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any rate you have the satisfaction of knowing that you have got a good article.

Next we come to the question of second-hand cars; and here, to begin with, I would say "Do not think of this unless you know enough about a car to recognise anything radically wrong or inherently weak, and are prepared to wait several months before getting a car." If so, then having decided, as before, on the make you want, you should study the advertisements in various motor papers, and also call at one or two well-known agents; they may have something in stock to suit you, or, at any rate, will let you know if they do get anything.

One should bear in mind that, though great strides have been made in the last few years in the production of small cheap cars, yet the well-known manufacturers have made only minor alterations in the mechanism of their cars, and one of their 1903 cars is probably as good as one of 1904 or as the 1905 will be.

When you do find something that you think will suit you, then get expert advice, even if you have to pay for it; and insist on a good long trial run over a "give and take" road. There are bargains to be had occasionally, but remember they are few and far between, and small cars by good makers are not often on the market. To most people who invest in a small car, purchase means the outlay of capital representing hard-earned savings; and therefore the question of getting a good car is a very important one, and the trouble taken in selection should be proportionate.

As regards the all-important question of selection, the most I can do is to try and direct attention to various points.

First as to size, or H.P. The tyro is inclined to think that this is a question principally of initial outlay; but let me say at once that this is an absolutely wrong idea, and that he could entertain no greater fallacy. To determine the size of car that will suit you, you must decide what yearly expenditure you are prepared to incur. No very definite figures are yet available; but we may take it that, whereas a 6 H.P. car (costing from £125 to £200) will cost about £60 a year on upkeep including depreciation, a 10–12 H.P. will probably cost nearly double this amount.

As regards the initial outlay, to the prime cost of the car a liberal sum must be added for extras such as lamps, pump, jack, tools, rugs, etc., and a certain number of spare parts which have to be purchased at once. (Some of the accessories mentioned above are included in the price of certain makes of car).

Next we come to type and mechanical arrangement. In advertisements a great deal is often made of the fact that a car has three or four speeds. Now in a small car there is no great advantage in a number of speeds. With the latest improvements in throttling, etc., most of the work of a car is done on the top speed, and only in traffic

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or on a steep hill is a lower gear resorted to, so that in a small car, like the 6 H.P., two speeds are quite sufficient. But in all cases a reverse is essential.

The chief points to be looked to in selecting a car are *simplicity of construction* and *accessibility of parts*. We must remember that an adjustment is often required on the roadside, perhaps in the rain; and when this is necessary to a part of the mechanism difficult of access, it becomes troublesome and often trying to the temper, and entails undue delay.

As regards tyres, if you intend to use your car in all weathers, some non-slipping device is imperative.

Now let us assume that the novice has actually bought a car. Of course he wants to get in and drive away at once; but while he is learning to drive I would advise him to put in some time in studying the mechanism of his car. It is not sufficient to know that the pulling of certain levers produces certain effects; the beginner should learn the reason of these effects, and what alteration is made in the arrangement of the mechanism. Besides this, I strongly advise him to learn practically how to take to pieces and put together again the various parts of the mechanism, and how to make the adjustments that will from time to time be necessary. It is not enough to know this theoretically; for on the roadside the novice will find that a good deal of theory goes a very little way, and a prolonged stoppage may result where only a few minutes would have sufficed had he possessed the requisite practice.

As I have said before, a new car requires certain adjustments and some of these will probably be done while the novice is learning to drive. For the rest he will find the value of the practical experience I have advocated.

The chief point to be attended to in "running-in" a car is *lubrication*. At first everything is stiff and tight; and unless care is taken that everything is thoroughly lubricated, it may mean considerable damage to the car through friction. At first the engine should be lubricated till the smoke of burnt oil is blown through the silencer, and the gear should be kept full of oil. Smoke and smell may be objectionable, but are better than running the risk of wearing away the walls of the piston chamber.

The oil must also be frequently run off, as particles of metal wear off and get into it; about every 25 miles should be sufficient. When this period of "running in" is ended, there is nothing left but the *care of the car*.

Here again lubrication is first in importance. The makers will say what they advise in this respect; and as we may assume that the novice intends to look after the car himself, he must make himself familiar with all the different bearings that require lubrication and must attend to them regularly.

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Cleanliness is the next thing. To ensure continual good running, it is essential that the mechanism should be kept thoroughly clean, as in time there is always the probability that dirt will find its way into the bearings. In this connection, I would advise everyone to have an under-cover fitted to his car to keep out the dust and dirt. It is the only way to secure cleanliness, and is, I consider, an absolute necessity, and certainly the most important accessory. Do not start using the car and leave the matter of an under-cover for future consideration; you will only get dirt on to the mechanism, and it will be impossible to thoroughly remove it without partially dismantling the car. Many people consider that it is only necessary to wash mud off a car about once a week, though why dirt should be left on a car any more than on a carriage I can never understand; it looks bad and does not do the paint any good.

Almost the most important part of a car is the *brake;* this should always receive special attention. You can never tell when you may have to rely on its thorough efficiency, and your life or that of another may depend on it. It is not sufficient to know that the brake is acting fairly well; it should always be in the best possible working order.

The one question that remains is that of *insurance*, and I strongly advise every owner to take this precaution. In the present state of public feeling, the motor driver is always in the wrong, and there is the ever present danger of people or children walking across the road in front of a car. In insurance parlance this is called the "third party risk," and is one that should always be covered. There are various companies, such as the Car & General, General Accident, etc., which specialise in motor insurance, and their terms and respective advantages can easily be compared.

Finally, I would add one more piece of advice;—Always thoroughly overhaul your car before starting on a long run. There may be some nut loose, some split pin missing, or some trifling adjustment required, which, if not attended to, will lay the foundation of trouble on the road.

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TRANSLATIONS.

DER WELTKRIEG.*

By AUGUST NIEMANN.—(Vobach & Co., Berlin—Leipzig).

Though the author's ideas of strategy and tactics are somewhat crude, this book is interesting as an illustration of views which appear to be entertained in some quarters on the Continent.

In his Preface the author recalls a conversation with a British Officer whom he met in India, in which the latter said that when he first served there as a subaltern the Russians were 1,500 miles from the frontier, when he returned as a captain 15 years later they were 500 miles away, and now they are actually at the passes leading to India.

He looks into the future and sees a war waged by the three allied powers—Germany, France and Russia—against their common enemy, England, with a new partition of the world as its result.

The scene opens with a conference of Russian statesmen at the Winter Palace in St. Petersburg, during which M. de Witte states that "It is the never-ending enmity of England which is responsible for the attack by Japan" and that it is necessary to put a stop to England's opposition to Russia's aims and interests. General Kuropatkin, called upon to unfold a plan of campaign says "There are three important passes leading from Afghanistan into India,—the Khaibar, the Bolan, and the Kurram,—and it suffices to say that we would find a way there. Habibullah Khan would join with 60,000 men as soon as we entered his country; he would indeed, be just as likely to join the British if they were first in the field, but nothing should prevent the Russians from being there soonest. I guarantee that within four weeks of the declaration of war a sufficiently strong army could be concentrated in the neighbourhood of Herat; this first army could, moreover, be followed by an unceasing stream of regiments and batteries; the reserves of the Russian Army are inexhaustible, and if necessary four million men and more than half a million horses could be brought into the field. I doubt, however, if the English would meet us in Afghanistan, and I consider they would be foolish to do so; for if they were defeated the Afghans would destroy them without mercy, whereas to us there would always be open a way of retreat through Turkestan. If the English Army were defeated, India would be lost to Great Britain; her power would be attacked on all sides by the Native

* A translation, by J. H. Freese, under the title *The Coming Conquest of England* has recently been published by Routledge.—EDR.

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Princes, who have been so cruelly robbed of their independence, while we would be looked upon as deliverers. The Anglo-Indian Army is much stronger on paper than in reality. It numbers nominally 200,000 men; but only one-third is British, and it consists of four Army Corps scattered over the whole of India. The Field Army would have to be newly organized, and at most it could not number more than 60,000 men; for, owing to the disloyalty of the people, the country could not be denuded of troops. My opinion is that the war should be carried into India, and that victory would rest with the Russians."

The Minister for Foreign Affairs next speaks. "I agree with what General Kuropatkin has said, but point out that a war with Great Britain would not be confined to one quarter of the globe. Especially at sea is trouble to be expected. It is therefore necessary to ask the question as to what would be the attitude of the other great powers. Negotiations have been proceeding, through the Russian Ambassador in Paris, with Mons. Delcassé and the President of the French Republic." He proceeds to read a despatch received that day, the gist of which is that France would declare war upon England immediately the Russian Army was put in motion against India; in consideration for this France demands a free hand in Tonking and Cochin China, Russia's assistance to acquire Egypt, and her support to French policy in Tunis and the rest of Africa. M. Delcassé also impresses upon Russia the necessity of winning over the German Emperor as an ally. remarking that the question of Alsace-Lorraine might wait, and that nothing could be more disastrous for France than a misunderstanding with Germany.

Chapter 2 takes us to the camp of a British Cavalry Regiment at Chandigot in British India. The sun has just set; and while the soldiers are amusing themselves with playing games and singing, their officers are less innocently employed. A group of seniors are sitting outside the mess tent, smoking their short pipes and drinking whiskey and soda, while inside the younger officers are playing their usual, game of poker. Among the seniors is a guest, who is introduced as Mr. Heideck, a young German travelling for a Hamburg firm of indigo importers.

For some time the game of poker proceeds quietly, but eventually all the Officers except two, Captains Irwin and McGregor, lay down their cards. These two raise each other until the stake reaches a lakh of rupees, when the hands are laid on the table and it is seen that McGregor has won. Irwin, who is a comparatively poor man, then leaves the tent. Heideck proceeds to the Dak Bungalow, where he becomes immersed in sad thoughts of Mrs. Edith Irwin, a beautiful young English lady to whom he had recently been introduced. Soon afterwards a stranger arrives, who introduces himself as a Russian travelling in silks and bronzes and subsequently confesses that he is Prince Fédor Andrejewitch Tschadschawadse, captain in the Russian Guards; Heideck admits that he himself is a captain of the German General Staff. Both are in India in order to find out all they can about the Anglo-Indian Army, and the Prince announces that General Iwanov is already on the march against the Indian Frontier.

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The next morning Heideck calls on the Maharajah of Chandigot in order to arrange a deal in indigo. He finds him looking rather annoyed, and full of complaints against the Government, which, he says, is becoming more tyrannical every day. He has just been ordered to supply 1,000 Infantry, 500 Cavalry, a battery of Artillery and 2,000 camels for service on the Frontier, and asks Heideck why troops are being concentrated there, remarking politely that as Heideck is not an Englishman he might possibly speak the truth. The latter, however, replies that he knows nothing.

Heideck subsequently has an interview with Col. Baird, O.C. Troops and Resident, who confides in him that the Russians are marching against Herat and that war would shortly be declared; and the former hastens to impart this confirmation of his intelligence to Prince Tschadschawadse, who decides to rejoin the Russian Army.

We now travel back to Europe and hear a conversation between the German Emperor and a Hamburg merchant, Herr Grubenhagen, who states that the whole of Germany is anxiously awaiting the moment for joining the Allies and prophesies, as one of the results of the war, the inclusion of Austria, Denmark, Norway and Sweden in the German Empire.

Back in India once more, we get a glimpse of the methods of British officials. Heideck is spending the evening with the Bairds. After dinner there arrive five ox-wagons with a small present of five lakhs of rupees from the Maharajah. Col. Baird thanks the messenger, the Rajah Tajahat, and says the five lakhs may be left pending instructions from the Viceroy as to their disposal. On the Rajah's departure the Colonel remarks to his guests that the money will be very useful in assisting to defray the expenses of preparing his command for war. He is doubtful whether he will make any report to the Viceroy about the incidents which have taken place; he thinks he would receive no thanks for doing so, as in the existing serious state of affairs the support of the native princes is very much required.

A few days later England declares war against Russia. France is evidently about to join, but the attitude of Germany is still doubtful.

Sir Bindon Blood, with the troops collected in the neighbourhood of Peshawar, was to advance at once up the Khaibar Pass on Kabul, while General Hunter was to move from Quetta on Kandahar. The Chandigot garrison had received orders to join the latter; but the day before the troops were to march an officer arrives on a motor car with a message from General Blood that the dispositions are all changed; the Russians had advanced over the Hindoo Khush and down the valley of the Indus* and General Blood was retiring southwards in order to avoid being cut off; all troops in Northern India, including General Hunter's Force, were now to concentrate at Multan.

The opening battle of the war takes place at Attock, and results in a success for the Russians. Owing to the inferior march discipline of the British troops there have been frequent halts, causing large gaps in the

* Officers, who know the country, will sympathize with Sir B. Blood's astonishment at being suddenly attacked by a large army from this direction.

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stream of troops approaching the bridge over the Indus.* The Russian advance guard, crossing the Kabul River just above its junction with the Indus in the mist of the early morning, chances upon one of these gaps. The main body of the British Army continues its march southwards, while the troops cut off surrender after a short resistance; they consist of 2,000 British and 3,000 Native troops, and the latter at once transfer their allegiance to Russia.

The Russian General halts for a few days in the neighbourhood of Attock, to collect stragglers and to effect a junction with an Army Corps coming down the Khaibar Pass. He then proceeds southwards with an army of 70,000 men.

On receipt of the news of the reverse at Attock all the British forces, which had been ordered to concentrate at Multan, are diverted to Lahore; and the Anglo-Indian Army, which by this time is 100,000 strong (including 25,000 whites), occupies a position north of Lahore, with its left flank on the River Ravi. Heideck, who has marched with the Chandigot garrison, criticises the British very freely; the camping arrangements and commissariat were bad, and the tactical dispositions and manœuvres antiquated.

The Battle of Lahore ends, as usual, in a decisive victory for the Russians. (It is not worth describing in detail, as the account shows a grotesque ignorance of military matters, especially of the organization of the Anglo-Indian Army, and the character and composition of the Native troops). The battle formation of the British consists of two lines, the first made up entirely of Native troops, and the second of British ones to prevent the former running away. The Hindu regiments march along with the ends of their *puggaris* hanging loose and ashes sprinkled on their heads, in token of their despair, as it is known that the Mahommedans intend to turn on them when the battle begins. After a feint on the left, which draws the British troops to that flank, the Russians vigorously assault the centre. All is soon confusion on the British side, sepoys shooting their officers, and Hindus fighting Mahommedans. Finally whole regiments of Mahommedans begin to desert to the enemy, the first to go being the contingent furnished by our friend the Maharajah of Chandigot. The British regiments fight gallantly but are overpowered by numbers. Heideck stays long enough to see Colonel Baird and Captain Irwin killed, and then rides off to look after the ladies who are staying in Lahore. On the way to the citadel, Mrs. Baird and her children are all murdered; and subsequently Mrs. Irwin is carried off by retainers of the Maharajah.

The next day Heideck is tried by court-martial as a spy and sentenced to be shot. Fortunately, while on the way to the place of execution, he is recognized by Prince Tschadschawadse's page; and the Prince, arriving in the nick of time, takes him away and treats him as a guest. He informs Heideck that the first news he heard on reaching the Russian Army was that Germany had also joined in the war against England, Austria and Italy still remaining neutral. Germany had mobilized half

* Apparently all the fortifications discovered by the author at Attock, when collecting materials for the book, consisted of the Old Fort and the towers at each end of the bridge.

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her Army and had occupied the Netherlands, while the French troops had entered Belgium; so that the whole coast opposite England was in the hands of the Allies, who were preparing for an invasion of that country.

The author now introduces us to a Cabinet Council in the Foreign Office in London. Despatches have been received from the Viceroy of India, describing the defeat at Lahore and stating that the Commander-in-Chief, with 5,000 men, has succeeded in reaching Delhi and will proceed to Cawnpur to collect a new Field Army, leaving the defence of Delhi to General Egerton.

The Minister for War remarks that no defeat in India or the Colonies can be a death-blow to the Empire, but the point to be considered is what steps are to be taken to protect the coast of England. The First Lord of the Admiralty says the Navy will do this. There are two Fleets in the Channel, one watching the French and one the Germans; while a third is in Copenhagen harbour to prevent the Russian Baltic Fleet uniting with the Allies. The Colonial Minister does not consider the dispositions satisfactory. The British Fleet should be united, and should compel the enemy to fight by attacking him in harbour and carrying out enterprises against the coast towns. This proposal is, however, overruled.

The question of land defences is next discussed. The War Minister states that 40,000 men have been despatched as reinforcements to India, and is of opinion that no more should be sent, as Great Britain is now denuded of troops. He wishes to enforce the Militia Ballot. But nothing is settled, and the meeting adjourns.

The scene again shifts to India. Prince Tschadschawadse has been detailed to command a detachment, which is to proceed to Simla in order to search the Government Offices for information. Heideck accepts an invitation to accompany him. The march is unopposed, and Simla is reached without any adventures except the rescue of Mrs. Irwin. The station is found to be deserted; but Heideck discovers Judge Advocate-General Kennedy, who agrees to take Mrs. Irwin and him to England. The Prince gives his permission; Bombay is reached without mishap; and the party embark on the P. & O. s s. *Caledonia*.

The voyage passes without incident until the Mediterranean is entered. About 24 hours out from Port Said, on the way to Brindisi, a strange vessel comes into view; this turns out to be a French cruiser, which is soon followed by three other fighting ships; the *Caledonia* heads first for Malta and then for Alexandria; an unsuccessful attempt to assist her is made by two British men-of-war, one of which is sunk and the other captured; she is then captured and a prize crew put aboard to take her to Toulon. The next night, however, a strong British fleet is encountered; the French Squadron is put to flight, and the *Caledonia* is escorted to Naples, where she deposits in the bank twenty million rupees brought home for the British Government.

Heideck now sets out to report himself in Berlin; and Mrs. Irwin, having with difficulty been persuaded that it is impossible for her to accompany the German troops, disguised as a soldier servant, decides to travel with the Kennedys to England.

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The author now treats us to some naval warfare in the North Sea. Heideck, who has been promoted Major and appointed to the charge of the Intelligence Service on the coast of Holland, is standing on the deck of the German cruiser *Gesion*, lying in the mouth of the Scheldt, when he sees a fishing smack enter the river. On examining her he finds concealed on board a paper containing a list of questions regarding the dispositions of the German Naval and Military Forces in the vicinity of Antwerp. After threatening the skipper Brandelaar with trial as a spy, he obtains the names of his informers in Holland. On visiting one of them, Herr Amelungen of Antwerp, Heideck finds a letter in cipher, giving a list of the German ships lying in Kiel harbour (including a large number of merchant steamers, evidently intended to be used as Transports) and stating that there are 60,000 German troops in the neighbourhood of Kiel ready to embark. Heideck re-writes this letter so as to convey the impression that it is from Antwerp, and not from Kiel, that the invading Army is to start; and gives it, with his own answers to the questions found on the fishing boat, to Brandelaar to convey to the British Admiral at Dover. He also forwards a letter to Mrs. Irwin by the same agency.

When Brandelaar returns, Mrs. Irwin accompanies him. She brings with her a paper, which she has succeeded in getting from the British Admiral's secretary, and which turns out to be a copy of an order from the Admiralty for an attack on the German fleets at Kiel and Antwerp. Heideck is so disgusted with Mrs. Irwin's treachery to her country that he will have nothing more to do with her; she therefore bribes another fisherman to take her back to England, and during the voyage she falls overboard and is drowned.

Heideck takes the order to the German Admiral. The scheme is for the German Fleet, being the weakest of the three Allies, to be attacked first; the British Fleet at Copenhagen is to enter Kiel harbour and destroy or capture the ships lying there; while at the same time Rear-Admiral Sir Percy Domvile, with a portion of the Channel Fleet formed in two divisions, is to enter the Scheldt and force his way up to Antwerp. A Reserve Squadron, under Prince Louis of Battenberg, is to watch for any attempt by the French Fleet to come to the assistance of the Germans. The attack is to be delivered on the 14th of July.

In consequence of the above intelligence an urgent message is sent to the French Admiral, and the embarkation of the troops at Kiel is proceeded with. On the evening of the 14th the flotilla of transports in Kiel harbour gets under way, and enters the Kaiser-Wilhelm Canal to proceed to the North Sea. It is well on its way by the following morning, when the British Fleet from Copenhagen begins to bombard the forts at the entrance to the harbour. A north-westerly course is steered and the Firth of Forth is reached without meeting a single British man-of-war. No opposition being encountered, the two Army Corps are landed and proceed on their march towards the south.

While the flotilla of transports is making its way towards the north Sir Percy Domvile delivers his attack on the Scheldt. During the night of the 14th the German Admiral leaves his moorings in the harbour of

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Antwerp, and anchors in the Eastern Scheldt to the north-east of the Island of Walcheren. On the morning of the 15th a few cruisers are despatched south-west to meet the British Fleet, with orders to retire before it up the Western Scheldt and thus convey the impression that the German Fleet is still at its anchorage in Antwerp harbour. As soon as the German Admiral receives intelligence that this manœuvre has been successfully carried out, he passes round the north of Walcheren Island with his battleships, sending his cruisers and torpedo boats back into the Western Scheldt. He is thus able to attack the British Fleet on its left flank, as it approaches the south-west corner of Walcheren; and when it turns to meet him, the cruisers and torpedo boats deliver their assault on its right rear. A long and bloody battle ensues; the French Fleet arriving at the critical moment, Sir Percy Domvile withdraws towards the mouth of the Thames; and the united French and German Fleets follow in pursuit.

Little more remains to be told. Immediately after the battle of the Scheldt a large French Army, with some regiments of Russian Guards, lands at Hastings; and the British troops, after a gallant resistance, are forced to give way before the superior leading of the French and Russian officers. The Russian, French and German allied forces are now in camp at Aldershot, with the headquarters at Hampton Court Palace; and Great Britain has sued for peace.

Preliminary negotiations are in progress regarding the settlement, and these are to be followed by a Conference of all nations at the Hague. It is not proposed to destroy Great Britain absolutely, but her power is to be considerably crippled. Russia is to take India, France Egypt, and Germany Walfisch Bay and other British possessions in South-West Africa. The fortifications of Gibraltar are to be dismantled and the place handed over to Spain It is probable that Belgium will join the French Republic, and the Netherlands become part of the German Empire.

F. W. BRUNNER.

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EQUIPMENT FOR VISUAL SIGNALLING IN DULL WEATHER.

A recent Supplement to the *Militär Wochenblätt* contained the report of a lecture given in February of last year before the Military Society of Berlin by Capt. Gross, instructor in the Balloon Battalion.

The lecture dealt with all the most modern means of transmitting military messages; and the following extract may be of interest in showing how the Germans borrowed an idea from another army, thoroughly tested it and worked it out on their own lines, and incorporated it in their organization.

In dealing with visual signalling, the lecturer, after discussing its advantages and disadvantages, says:—

> It can therefore be easily understood that, though unreasonably, visual signalling came to be thought of little importance in our army after the introduction of the electric telegraph, and quite an exceptional occurrence was required to bring its military possibilities again into prominence.
>
> His Majesty the Emperor noticed the good services rendered by the English signalling staff in the autumn manœuvres of 1899, and the apparatus, which had proved itself serviceable in India and South Africa, was placed by the English Government at his disposal. Experiments were carried out by His Majesty's command, and our army was to be provided with an equipment after the utility of visual signals had been carefully considered.
>
> The result of nearly ten years' experiments proved that, of all signalling equipments tested, the English one was the best and most serviceable; but that even theirs was unable to ensure rapid and certain communication in our climate over long distances on cloudy days. Their portable helio proved itself exceptionally well suited for signalling, even in our latitudes, up to 100 kilomètres during sunshine; but their limelight on the other hand, when used by day with an overcast sky, was only visible up to 8 kilomètres. The successful use of signalling during the Boer war made it seem advisable to improve the apparatus by further trial and experiment so as to make it work successfully in our climate.
>
> The zeal and combined efforts of the Experimental Section of the Communication Troops, the 1st Battalion Telegraphs, and the Cavalry School of Telegraphs have at last produced a signalling apparatus which is of wider application than the English, and makes another step towards the perfection of the signalling service of our army. It is of course of the greatest use in directing an army, and especially

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in keeping touch with cavalry scouts. The helio alone is unsuited to our climate, in which the sun often does not shine for days together. It must be accompanied by an artificial light, strong enough to allow of its use by day over the longest distances found necessary in practice.

The ordinary sources of artificial light known up to the present were either too weak or their operation and transport were such as to prohibit their use in the field. In the course of experiments in this direction, Dr. Knöfler, a chemist, found that a proper mixture of oxygen and acetylene gases gives a much hotter flame than the oxyhydrogen jet usually used for signalling purposes. Small plates of thorium can be brought to a white heat by it, and they are then capable of giving about a 500 standard candle power light. If all the rays proceeding from the plate are caught and concentrated by a system of lenses, as in a lighthouse, and emitted as a parallel beam, the intensity rises at once to 80,000 standard candles. In this way an artificial light of quite exceptional power is obtained.

It is on this principle that the new Field Service signal lamp, Mark C/1902, has been constructed. A removable head contains the lenses, the thorium plate and the burner. The gas is brought to the burner in rubber tubes; and the lamp, placed on a light tripod, can be turned in any required direction. A helio and telescope are so arranged that, firmly connected to the lamp, the optical axes of all three are parallel. By this means it is possible, while working with the helio, to change to lamp signals or *vice versâ* without interruption, as the sun goes in or comes out. Besides this it is easy to direct the lamp or helio on the other station, as either has only to be laid by the telescope.

The whole apparatus for making the gas is quite portable. The acetylene is made in a chamber from calcium carbide and water, just as in the ordinary acetylene cycle lamp. The oxygen is carried compressed in steel cylinders in the same way as hydrogen for the Balloon Section. One of these small cylinders can be attached to the saddle and holds enough oxygen for several hours' work.

With this apparatus signals can be read under favourable conditions up to 50 kilomètres, and occasionally at still longer distances. As, however, the selection of signal station points is determined for the most part by the progress of the operations, and it is not usually possible to select especially favourable positions, the average distance between stations on service has been laid down as from 12—15 kilomètres.

With a well-considered system and good instruction in peace time, successful results may confidently be expected in the following cases, as proved by experience during the grand manœuvres and by the Field signalling parties in China:—

(1). To connect troops separated by insurmountable obstacles, such as a big river, or during a siege.

(2). To connect a field army and a fleet acting together, when wireless telegraphy is not available.

(3). In scouting, to hasten the transmission of pressing reports from officers' patrols, contact squadrons, and the cavalry screen in general, which may be many miles in advance of Headquarters.

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(4). Lastly, at times, to replace interrupted telegraphic or other means of communication in ordinary use.

Further technical improvement of the equipment is, generally speaking, impracticable; and it will be the duty of the troops entrusted with the service of this somewhat difficult apparatus to attain the maximum possible skill, after which a distinct organization and thorough training during peace time will be required.

T. T. BEHRENS.

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NOTICES OF MAGAZINES.

NATURE.

GREAT GOLFERS AND THEIR METHODS.—This book by Mr. Beldam has a scientific value quite apart from the "science" and art of the game. Every golfer knows the value of steady and accurate putting, and how curiously variable is his "form" in this respect. Mr. Beldam's excellent photographs bring out the very familiar fact that stance and pose are of comparative insignificance. Professor Tait was the first to bring scientific principles to bear upon the mystery of the flight of a golf ball. His papers on the rotating spherical projectile virtually form a new chapter in the dynamics of rotation. In these papers he lays down clearly the conditions which must be fulfilled if a man is to drive a far and straight ball. Slicing, putting, topping, are all completely explained along the lines of Newton's note on the deflection of a tennis ball in air (which both Euler and Poisson rejected as of no account). Tait showed how the ball must be started if it is to finish aright. The difficulty the golfer experiences is to give the proper start, and the mode of solution is as varied as the temperament of the player. There must, however, be a best way for every individual, and in discovering this, he should be guided by scientific principles. Mr. Beldam gives accurate pictures of some of our best golfers, catching the player at the very instant the ball is struck or just before the impact takes place. Plate XXVIII., said to be taken in $\frac{1}{1000}$ of a second, has a blurred image of the club head, 4 inches broad, giving a velocity of about 370 feet per second for the club head *after* impact. This would mean fully 900 feet per second for the ball, about double of that which Professor Tait calculated for a well-driven ball on leaving the ground.

THE SIMPLON TUNNEL.—The length of the tunnel will be 12¼ miles, all of which has been penetrated (1st November, 1904) with the exception of about 260 yards near the middle. The work consists of two single-line tunnels 50 feet apart, axis to axis. The object of having two tunnels in place of one has been fully justified for the following reasons:—(*a*). The ventilation is much more efficient, one tunnel being used as an "intake" for fresh air, which is blown in by high-speed fans, working with a water-gauge of 9 inches, the other being the outlet. (*b*). In case of derailment of a train occurring, it cannot possibly run into a train in the opposite direction. (*c*). When repairs are required, one tunnel can be closed at a time, the traffic being conducted in the other; and finally (*d*) the crushing weight of the material overhead is much more easily dealt with than it would be in a double-line tunnel; the overlying rocks extending to a height of

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7,005 feet. The tunnel is arched throughout, the pressure which has been encountered is so great, that in one place the arching of granite blocks is 2 mètres in thickness. The setting out is checked monthly; a small slit of light is thrown into the tunnel, which by the aid of theodolites is taken right up to the working face. It is anticipated that when the actual meeting of Switzerland and Italy takes place under Mount Leone, the error in direction will be under 18 inches.

The gradient rises from each end of the tunnel towards the middle so as to provide efficient drainage, a hot spring having been met with on the Swiss side, with a flow of 12,000 gallons per minute. The question arises from whence the great heat of the spring comes, for although borings in all parts of the world give an approximate rise of 1° F. in temperature for each 70 feet of vertical depth, this is insufficient to account for the great heat which has been encountered. A jet of cold water is played into the fissure from which the hot water is escaping; it is thus cooled down so as to enable the workmen to continue the drilling and blasting. It is expected that within three months of the piercement, trains will be running.

COLOUR PHOTOGRAPHY.—Messrs. Lumière use one screen only for the three-colour process. They sort out from potato starch granules from 0·015 to 0·02 mm. in diameter and colour separate lots of these, red, green, and violet respectively. When quite dry the coloured granules are mixed in such proportions that the mass appears grey, and a waxed glass is coated with them only one granule thick. To prevent the interstices from passing white light, they are filled up with a fine black powder and are then coated with a varnish of the same refractivity as the starch. By this means an irregular-grained triple-colour screen is obtained. It is then coated with a sensitised emulsion. The plate is exposed through the glass, developed, the silver image dissolved, and the remaining silver salt reduced to the metallic state to form the image. Thus is obtained the completed transparency. There must be many practical difficulties to surmount in the preparation of such compound plates, but the making of coloured transparencies must be much more simple than when three negatives and three prints have to be made.

SOLAR ECLIPSE.—Mr. Croker is to defray the cost of three expeditions of the Lick Observatory to observe the total solar eclipse of August 30th, 1905, one going to Labrador, another to Spain and the third to Egypt. At each of these stations the corona will be photographed with a camera of 5 inches aperture and 40 feet focus.

W. E. WARRAND.

BULLETIN OF THE INTERNATIONAL RAILWAY CONGRESS.

July, 1904.

AUTOMATIC COUPLERS.—A *résumé* of the state of affairs in England at present. No really satisfactory auto-coupler seems to have been devised yet, and the difficulties of the transition stage are great; moreover, the expense involved in the *process of changing* from non-automatic to auto-

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matic would be considerable. Full experiments and trials are necessary before any definite steps towards bringing such couplings into general use can be made.

SLOW FREIGHT RATES.—By H. Smart (Sec., R.C.H.)—A most valuable summary of present conditions in England, shewing how the classification has been arrived at, and the general principles which determine the fixing of rates. English Law does not provide for raising a rate because it is unremunerative, or because the line is not paying reasonably. I think it is the case that certain American railways have raised their rates lately because working cost has gone up.

AMERICAN LOCOMOTIVE PRACTICE (see *R.E.J., July*, 1904).—This number contains particulars of the discussion and correspondence on Mr. Cowan's paper, of which some account has been given. A number of interesting points are brought out, of which it may be of interest to give some notion.

The author alludes to a type of engine known as the "four-cylinder Vauclain balanced Compound," differing from the type we are accustomed to associate with the name of Vauclain, as it has two cylinders inside the frame and two outside, instead of a high and a low pressure cylinder with a common crosshead on each side outside. The arrangement sounds very like that of the de Glehn compound, but the high and low pressure cylinders on each side are in one casting, in which is also a single piston valve controlling the steam distribution in both cylinders. All connecting rods work to the same axle, the cranks set at 90°, and the crank pins at 180° to their respective h.p. cranks. The h.p. pistons are sometimes filled with metal so as to equalise weights and effect a balance. In the pattern of Vauclain engines which have both piston-rods connected to the same crosshead there appears to be much risk of breaking the cylinders, by reason of the unequal amount of work done in them.

It appears to be very generally held in England that piston valves use more steam than flat valves, but some very good examples are quoted of economical working, and Mr. Churchward says that there is no reason to despair of getting tight piston valves before long. At any rate they are very commonly used in American practice.

The substance of the remarks made confirms the impression that real interchangeability, of which so much has been prated, is far from being attained at present in American loco. design. "When allowed a free hand, the locomotive builder did not trouble himself much about the interchangeability of the parts in the interest of the purchasing railway. He had a variety of drawings, and whenever possible parts in stock which had to perform a similar duty to those required were worked in." The builders had the trade in their own hands and railways only secured a measure of standardisation by getting successive orders from the same builders. Again, when each order is for a heavier type of engine arrival at a standard type is indefinitely postponed. One writer remarks as regards finish of working parts and so forth that the American engine is as much the commercial man's as the engineer's engine, probably because the builders have a freer hand than in England. The want of uniformity in details is considerably felt when engines come in for repairs in the

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running shed, and such a thing as a broken spring, for example, cannot be replaced by taking from another of those in for repairs.

The author's opinion as to the disadvantage of training men for one job only is generally agreed in by those who remark on the paper; one or two instances are mentioned where men had a very poor idea of how to put right such things as twisted pieces sent them from the machine or forge (apparently this is by no means unknown). Again, surface finish has been found very valuable in detecting flaws in such things as axles. The American policy as to foundry work seems to be "make quickly and trust to luck for obtaining a fair proportion of good castings," but, on the other hand, many works take infinite pains over both chemical and physical tests of their metal.

There seems no doubt that the American engine is extravagant in fuel, and the enormous fire boxes now often fitted are more than one man can properly feed. More boiler power is allowed proportionally, but American engineers have been accustomed to build their engines with a wide range of power, that is, short laps, long leads, and ample clearances. Again, they reckon something like 10% higher mean effective pressure at the cylinders than English engineers do.

BIG WAGONS (GERMANY).—Some notes on recent experience.

It is apparently established (from experience with coal traffic mostly) that:—

(1). The ratio of paying load to tare is improved.
(2). Length of trains is decreased.
(3). Cost of haulage is reduced (but information is imperfect on this point).
(4). Time and labour are saved in unloading. Hence
(5). Wagons stand idle less time, and less rolling stock is required to do the work.
(6). Cost of maintenance relative to tonnage capacity is reduced.

November, 1904.

The greater part of this number is taken up with two reports, to be presented at the next session of the Railway Congress, on "Rails for lines with fast trains." The reporters are Mr. P. H. Dudley for America, and Mr. Van Bogaert (of the Belgian State Railway) for other countries.

The reports give an excellent general survey of the latest practice; and in fact resolve themselves into a general consideration of the best type of permanent way, for the rails cannot be satisfactorily considered without the sub-structure supporting them.

It is impossible to go into them in detail without exceeding due limits of space, and it must suffice to mention one or two prominent points. The articles will well repay perusal.

(1). The increased stiffness of permanent way, including sleepers and ballast as well as rails, has permitted much development of motive power and of rolling stock.

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(2). The spacing and loading of the wheels have become the ruling factors in determining the nature of the depression, when the road passes from the unloaded to the loaded condition.

(3). The effect of using stiffer rails and stiffer joints is to increase the capacity to bear large bending moments and so bring on to the sleepers and ballast underneath a distributed instead of a concentrated load.

(4). When the track gives way little under the rolling load the pressure between wheels and head of rail is greater, consequently harder metal is needed for resistance.

It also appears advantageous to increase the width of the railhead and to make it flat instead of rounded, as one or two companies do now.

(5). With good rolling stock and well-balanced locomotives, however, the need for heavy rails is not so paramount.

(6). Rails rolled at a low temperature, and consequently of fine crystallisation only, wear best and are less liable to fracture.

C. E. VICKERS.

THE RAILWAY ENGINEER.

December, 1904.

LOW PRESSURE POWER SIGNALLING (L. & S.W.R.).—It is intended to equip the sections between Basingstoke and Woking, and some portions are already at work. The "normal safety" system is used; the train only puts the signals to "danger" to protect itself for a section's length behind. There is no overlap, to guard against trains over-running signals; usually elsewhere a certain distance is provided to ensure that before one train is allowed to enter the section the previous train must have wholly passed beyond it.

The general principle of the actuation is that a train entering the section, and so forming a connection between the rails, short circuits a track battery and so de-energises a magnet and drops its armature. This operates a valve which allows the air pressure to be released and so to put the signal "on." As the signal goes "on," it breaks the circuit to its distant signal, so that it goes "on" also. When the train goes out of section the magnet is re-energised; the valve then permits the air pressure to be applied again and so lowers the signal.

When the signals are operated from a signal box, there is automatic replacement; the valve operated by the magnet in the manner previously mentioned allows air to pass to a small piston attached to the lever slide, so as to replace it when the section is cleared. The lever being replaced, the cut-off valve is opened and allows the signal to return to its normal position.

It is somewhat difficult to attempt to explain the system clearly without the diagrams. Automatic signalling, however, deserves study, as, on account of the saving of labour it effects, it is bound to be extensively adopted.

C. E. VICKERS.

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REVUE D'HISTOIRE.

November, 1904.

THE CAMPAIGNS OF MARSHAL SAXE.—*Campaign of* 1745.—The investment and siege of Tournai are described, down to the eve of the battle of Fontenoy. The officer commanding the artillery was not satisfied with the progress of the siege batteries. "The officers answered that the fire of the place hindered them from working; he asked them where were the dead and wounded. He placed them in arrest and reported it to M. de Saxe, who said this was not enough, they must be sent to Lille to be imprisoned, and their names must be sent to the Court that they might be cashiered."

THE CAMPAIGN OF 1800 IN GERMANY.—The successive reorganisations of the army of the Rhine, under Moreau, in the first three months of the year. Eventually it formed four Corps under the command of Lecourbe, St. Cyr, Sainte-Suzanne, and Moreau himself.

THE WAR OF 1870-1871.—*The 18th August in Lorraine.*—The account of the battle of Gravelotte is continued, and is carried up to the end of the day, so far as the northern part of the battlefield is concerned. Ladmirault, commanding the IVth Corps, held his ground at Amanvillers, and sent urgent messages to Bourbaki (commanding the Guard) to come and help him, that he might take the offensive. Bourbaki moved up to do so, but on getting clear of the woods he saw the stream of fugitives from Saint-Privat. "This is not well done," he said to Ladmirault's aide-de-camp. "You promised me a victory, and you are bringing me to take part in a rout." He gave the word "right-about turn" to his men, and marched them back to the position they had been holding before, in reserve. This retrograde movement added to the panic which had already begun in rear of the line of battle.

E. M. LLOYD.

MILITÄRISCHE BLÄTTER.

Nos. 21, 22, 23, 24.

The strategical importance of Egypt is treated in a series of articles which do not throw any particular additional light on the subject; they are, however, agreeable reading. The writer ascribes the fortifications of Suakim to Colonel Kitchener, but this is surely an error.

The autumn manœuvres in France are touched upon, and it is stated that much has been done in this year to give them more the appearance of war than has heretofore been the case. For example, battles were not always decided on the day on which they were commenced, it being recognized now that a combat may last for several days, and this is said to be an application of the knowledge gained from the War in progress; but the Boer War taught us this, without searching earlier history. Night attacks were not in favour, though the present war shows many instances where they have been attended with success, and surely there are no operations that armies require to be practised in more than in

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these. They are very unpopular, as they may involve long marches and consequent fatigue and exhaustion to the troops, and artillery and cavalry are not utilized. A massing of guns for suitable purposes was often observed ; the theories on the subject suggested by the experiences of the Boer War appear to be now definitely put away. The usual final parade was this year dispensed with, which is highly approved of—this function leading often to many strategical absurdities, in order to get the rival forces in proximity to the place chosen for the march past.

Lessons from the present War are dealt with. The writer is well pleased with the aptitude which the German pupils have displayed, and that the fundamental principles of German prescriptions for the combat, adopted in their entirety by the Japanese, have shown themselves superior to the Russian of 1900, shock tactics and volley firing, recommended in the latter, having completely failed. The offensive, so dear to the modern German, is declared to have been most skilfully used by the Japanese, though it is recognized that the latter's successes have been due more to tactical training than to strategical leading ; their battles up to the present have only been half victory, and this must be looked upon as a consequence of deficient strategical ability. The success with which the Japanese have suppressed all information from their side is remarkable ; even their losses in the different battles are unknown to the public, and at sea only months after a catastrophe does it leak out that a ship has been lost. It is likely that in future wars all states will follow the lead given by the Japanese, and that the special correspondent will sink into insignificance. Many successful night marches have been carried out by the Japs, and in some cases the attacks consequent on them have been attended with success ; this was notably the case on the 27th July, when the 2nd Division attacked in the grey of the morning, after a long night march, the heights of Taotingling, and captured them in spite of a most vigorous resistance. Much praise is given to the Russian engineer for the skill he has shown in field fortification, although shelter trenches have at times been unfortunately placed ; but this may be due to bad execution on the part of the infantry. The Russian cavalry (mostly Cossacks) has hardly been engaged in battle ; at Wafungfoo it obtained some success ; in its principal duty (covering and discovering) it has singularly failed, and many checks in operations are ascribed to this cause. The handling of the artillery by the Japanese is quite in accordance with modern German ideas—massing of guns for an overpowering concentric fire on the decisive spot where the infantry attack is to be pushed home. On the Russian side scattering of guns has been the rule, at least in the earlier stages of the War, and they have suffered accordingly. The important *rôle* played by the 12-centimètre Japanese howitzers in the battle of the Yalu and other engagements is recognized, and steps are being taken in France to provide Army Corps with suitable howitzers. Heavy guns are not now attached to these.

The introduction of the two years' term of service is discussed in two articles, both worth reading. It is admitted that more trained men will be forthcoming ; but it is also recognized that great additional work will be thrown on the permanent cadres, and that the difficulty of providing

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suitable N.C.O.'s in the future, already felt on account of increased prosperity in German trade and consequent openings in civil life, will increase by reason of this measure. The question also arises whether the officer class may not suffer by it, making the profession less sought after than it has hitherto been; indeed, for some years regimental service has not been so popular as it used to be, and the greatest difficulty is experienced in keeping officers with their regiments; and it is notorious that many regiments in out-of-the-way commands suffer much on this account, those officers who get employed on staff and colonial duties being as a rule the most influential and best in the regiment. According to the new law, the peace footing of the German Army, 495,500 rank and file, will be increased to 505,839; but adding to this the officers and under-officers, probably about 60,000 men, it will bring the peace strength up to about 560,000 men. As heretofore, the peace strength is represented by little less than 1 per cent. of the population, the proportion supplied by the different states of the Confederation being;—Prussia, 392,979, Bavaria, 55,424, Saxony, 37,711, and Würtemberg, 19,725; the strength by units being:—633 battalions of infantry, 510 squadrons, 574 batteries, 40 battalions of garrison artillery, 29 battalions of engineers, 12 battalions of communication troops and 23 battalions of train, the whole being distributed among the fortresses and 23 Army Corps. As Würtemberg, according to the new law, will not be able to furnish its contingent, in consequence of its population not keeping pace with the other states of the Empire, its deficiency of 256 recruits will be made good by Prussia, and in this way the per centage will be the same for all the states of the Empire. New cavalry regiments, infantry battalions, batteries and engineers will be formed.

Von Trotha continues his "History of War," and from his study of Liaoyan and Schaho, although recognizing the great absolute loss at these battles, concludes they cannot compare for a moment in losses per day with Zorndorf, Borodino, Mars la Tour or Gravelotte; but the marvellous is the astounding moral force displayed by both combatants in these battles of many days duration. The idea of "Buren Angriffs," which held its sway for some time, has been killed and buried in the East Asiatic battlefields. The supply of ammunition in these battles has apparently never failed; it is a proof of the good organization and fire discipline of both armies. The hand-to-hand combats with the bayonet speak volumes for the moral qualities of the combatants.

R. A. LIVESAY.

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A History of the Indian Mutiny, reviewed and illustrated from original documents by G. W. Forrest, C.I.E. (Size 9½ × 7. 38s. W. Blackwood & Sons).

The Navy as I have known it, by Admiral Sir E. R. Fremantle, K C.M.G. (16s. Cassell & Co.).

Strategy illustrated by British Campaigns, by Capt. Macquoid, D.S.O. (9 × 6. 10s. 6d. Cassell & Co.).

The Sikhs, by General Sir John J. H. Gordon, K.C.B. (9½ × 7. 7s. 6d. W. Blackwood & Sons).

Tactics of Today, by Lieut.-Colonel C. E. Callwell, R.G.A. (2s. 6d. W. Blackwood & Sons).

Reminiscences of the Civil War, by General John B. Gordon, Confederate Army. (9 × 6. Constable).

Regulations for Intelligence Duties in the Field. War Office. (7 × 5. 2d. Eyre & Spottiswoode).

Report on the Medical Arrangements of the South African War, by Surgeon-General Sir W. D. Wilson, K.C.M.G. Official. (Folio. 7s. 6d. Eyre & Spottiswoode).

Report on Work of Telegraph Section, Somaliland Field Force. Official. (Folio).

The History of the Victoria Cross, by Philip A. Wilkins. (4to. 21s. Constable & Co.).

Story of the Campaign in Eastern Virginia, by Lieut.-Colonel H. M. E. Brunker. (7½ × 5. 7s. 6d. Foster, Groom & Co.).

My Service in the Indian Army and After, by General Sir J. L. Vaughan, K.C.B. (9 × 5½. Constable).

Glossary of Geographical and Technical Terms, by A. Knox. Supplementary Volume to Stanford's *Compendium of Geography and Travel.* (8 × 5½. 15s. E. Stanford).

The Electrical Transmission of Energy, a Manual for the designing of Electrical Circuits, by A. V. Abbott, C.E. (9 × 6. 30s. Crosby Lockwood).

Astronomical Discoveries, by H. H. Turner, F.R.S. (9 × 5¾. 10s. 6d. Arnold).

Maxwell's Theory and Wireless Telegraphy, by H. Poincaré and F. K. Vreeland. (8½ × 5½. 10s. 6d. Constable).

Linear Perspective Projection (Textbook for the Royal Military Academy, Woolwich), by Major E. H. Stafford, R.E. 2 vols., letterpress and plates. (6s. Eyre & Spottiswoode).

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The White Man in Nigeria, by G. D. Hazzledine. (9 × 6. 10s. 6d. E. Arnold).

Through the Unknown Pamirs. The Second Danish Pamir Expedition, 1898–99, by O. Olufsen. (9 × 6. 15s. W. Heinemann).

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India, by Colonel Sir T. H. Holdich, K.C.M.G. (9 × 6. 7s. 6d. Oxford University Press).

Game, Shore and Water Birds of India, by Colonel A. Le Messurier, C.I.E., F.Z.S., F.G.S., late R.E. 4th edition. (10½ × 7. 21s. W. Thacker & Co.).

English Estate Forestry, by A. C. Forbes. (12s. 6d. Arnold).

The Governance of England, by Sidney Low, B.A. (7s. 6d. T. Fisher Unwin).

Hints on Horses, by Capt. M. C. Gonne, R.A. (8 × 8⅜. 5s. Murray).

A Geometrical Political Economy. H. Cunynghame, C.B., M.A. (7½ × 5. 2s. 6d. Clarendon Press, Oxford).

The Cross Bow, by Sir Ralph Payne-Gallwey, Bt. (11 × 9. £3 3s. Longmans, Green & Co.).

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Sandhurst (Dec., 1904): 24th, G. de la Poer Beresford; 32nd, H. G. C. Colville; 68th, C. H. Blackburn. (Two others previously).

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SUPPLEMENT

TO THE

Royal Engineers Journal

VOL. I. No. 1. JANUARY, 1905.

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OFFICERS who intend to contribute, and have not already sent their subscriptions, are requested to do so at their earliest convenience.

The period for which Messrs Agnew & Son agreed to reserve engravings of the portrait for certain Branch Messes expired on 31st ultimo; and the sum received by then was insufficient to justify the issue yet of an order for any copies. The amounts received and still required are shown on page 17.

R.E. SOUTH AFRICAN WAR MEMORIAL.

THE following circular has been despatched to officers concerned, in the hope of making up the present deficit:—

R.E. INSTITUTE,

10. 12. 04.

DEAR SIR,

The South African Memorial Arch is now completed according to the design published in the December, 1903, number of the *R.E. Journal*,—with the exception of the gates, which it has been decided to omit.

The subscriptions received are £50 short of the cost of the work that has been carried out; and the Committee are anxious to make two additions as follows:—

(i.). Two ornamental lamps, to light the road and paths under and at the sides of the Arch; Approximate cost, £40.

(ii.). Bronze tablets under the archway to record the R.E. units that served in the war and the unveiling by His Majesty The King; Approximate cost, £60.

Thus £150 is still required, of which £50 is absolutely necessary to defray liabilities.

There are still about 320 officers who have neither subscribed to the Memorial nor expressed their unwillingness to do so; and the Committee cannot help thinking that the sum required would be easily obtained if these officers fully realized the circumstances of the case.

As the Arch is the only Corps Memorial of the South African War, the Committee venture to hope you will be able to contribute something towards its cost.

Yours faithfully,

A. T. MOORE *Major, R.E.,*
Hon. Secretary.

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R.E. INSTITUTE PUBLICATIONS.

Proposed Alterations.

In response to the Committee's proposals in their circular of the 17th November last, only six Members have notified complete dissent. On the other hand, although assents were not asked for, a considerable number of Officers have written to express their cordial approval. At the same time several Officers have made various suggestions and criticisms on minor points.

It has therefore been decided to adopt the proposals of the circular in their main features.

In response to representations received an *Alphabetical List of Full Pay Officers*, in foolscap form, is issued to Members herewith; and this will, it is hoped, sufficiently replace the old *Alphabetical List* for this year.

It has also been decided to publish the new *Supplement to the Journal* in the same size as the new *Journal* itself and separately, instead of making it the same size as and stitched to the new *Monthly List*. From February inclusive all three publications will be sent out together; and Officers abroad are requested to inform the Secretary if their consignments arrive in a damaged condition. It will be more necessary than ever for Members to keep the Secretary informed of impending changes in their addresses.

Other suggestions received will be duly considered by the Committee, and such action taken as thought necessary to meet the wishes of the majority of Members.

With reference to the issue of the *Professional Papers* the attention of Officers, who wish to receive them in volume form, is drawn to the accompanying slip.

As regards the new *Journal*, its success will of course depend mainly on the goodwill and support of Officers of the Corps; and it is confidently hoped that a sufficient number will contribute their views and experiences to procure for it an honourable place amongst the military magazines of the present day.

As regards the new *Supplement*, its real restriction to private circulation with no presentation list, will allow a greater freedom of discussion on all private concerns of the Corps; frequent contributions of Station News, Personal Notes, Accounts of Games, etc., will enable Officers to keep themselves acquainted with the doings of their comrades in all parts of the world; and the whole should thus continue to maintain that bond of union which has always been the object of the old *Journal*.

A PERMANENT SCHEME FOR R.E. MEMORIALS.

The letters from Major Winn and Major Baker Brown in the September and October numbers of the *R.E. Journal* have not been favoured with the further expression of views which they merited. The following remarks are therefore submitted in the hope that the matter may be ventilated sufficiently to allow of some definite action being taken.

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Every memorial scheme naturally resolves itself into three main questions :—

(1). The agency for its execution.
(2). The question of form.
(3). The question of funds.

The two last are of course intimately concerned with each other, but for convenience they are here treated separately.

(1). By "Agency" is meant the Committee to whom the carrying out of any memorial is entrusted.

Hitherto it has been the custom for the I.G.F. to appoint a Provisional Committee to take preliminary steps, and this Committee has either been confirmed at a subsequent Corps Meeting or been replaced by another Committee elected at that Meeting. This procedure has necessarily involved delay; and now that the abolition of the I.G.F. has left the Corps without a real head, it cannot be denied that Major Winn's proposal for a permanent Memorials Fund and Committee best solves the difficulty that has been created.

As regards the constitution of the Committee, five members, as mentioned below, would probably suffice. The three *ex-officio* ones would ensure the attendance of a *quorum*, and would also represent headquarters and the two principal home stations of the Corps; whilst the two elected members would give subscribers sufficient voice in the management of the Fund. The Secretaryship would be best entrusted to a permanent official. It would be advisable for the Committee to propose the election by a Corps Meeting of one or more additional temporary members in the case of any important memorial, or to have the power of co-opting additional members under similar circumstances.

(2). As regards "Form," the existence of a permanent Fund and a permanent Committee would not in itself prevent the recurrence of such disagreements as have occurred in the past.

The two latest memorials have definitely proved;—firstly that the Annual Corps Meetings (though the only representative assembly that is possible) do not in all matters accurately voice the opinion of the Corps as a whole, for the simple reason that officers do not attend in sufficient numbers; and secondly that it is impracticable to obtain the opinion of a true majority of the Corps by the only alternative means, viz., a direct reference to each individual officer. From these follows the corollary that, in most cases, it is impossible to formulate a scheme that will meet with general approval. Diversity of ideas must necessarily result in a body of capable and thinking men of various careers and employments; and this is no doubt a valuable asset in the long run. The trouble lies in the impossibility (apparently) of ascertaining the views of a sufficient number to enable a Committee to decide what proposal would find most support.

The difficulty caused by conflicting opinions in the case of *every* memorial could be overcome by the Corps definitely deciding on a permanent scheme to which all future memorials would be an addition.

Major Winn proposes Cottage Homes for deserving non-commissioned

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officers and men; but if a charitable object is the scheme to be adopted, it is at least open to question whether enough is not already done for our old soldiers and their families by the £1,800—£2,000 per annum which is expended by the Corps Charitable Fund, and whether we would not be justified in devoting some of our memorials to the benefit of necessitous widows and orphans of officers through some such institution as the new Queen Alexandra Homes at Wimbledon. The Cottage Homes scheme would apparently cost £450 per cottage; this would probably be more than a permanent Fund could afford for any one memorial, and memorials to some at least of our distinguished dead would therefore have to be postponed until it was possible to combine them with others.

It is also open to question whether a charitable object is necessarily the best method by which a Corps or Regiment can perpetuate the memory of a distinguished comrade. In honouring such a one we indirectly honour the organization and training that produced him, and we indirectly exhort his successors in after generations to "go and do likewise"; if this point of view be correct, it is probable that some visible object, so situated as to be constantly in evidence to the rising generation, would appear the most suitable form of memorial. Such a visible reminder of great deeds or a strenuous life would be a Museum at the headquarters of the Corps; the building itself would be a memorial to one or more persons or of one or more campaigns, and could contain relics and trophies that would make it a sort of Valhalla. This proposal has the merit that it would render possible the commemoration of the numerous minor campaigns, such for instance (to take the most recent) as the Tirah, the last Soudan, the Somaliland and the Thibet, all of which are at present unrepresented by memorials so far as the non-commissioned ranks of the Corps are concerned; and it would also be a means of recording those of our comrades whom fate has prevented reaching the highest pinnacle of fame, such as the late Sir Robert Grant.

Whatever permanent scheme was adopted, it would still be feasible to have a duplex memorial of any individual. General——for instance might be commemorated by a tablet in the Museum and also by a portrait in the Headquarter Mess.

(3). As regards "Funds" too, the existence of a permanent Fund and a permanent Committee would not be in all cases a solution of the difficulty. In the event of important and therefore costly memorials there would still be a recurrence of the *impasse* due to the fact that many people are loth to subscribe in the dark to some unknown scheme, whilst, contrariwise, a Committee cannot formulate a scheme until it knows the amount that will be at its disposal. It would, however, be a solution for all minor cases, and a step towards one in others.

There is no truer proverb than "*Bis dat qui cito dat*," which means "Fill up the subscription form at once before somebody puts it in the waste-paper basket." But good intentions frequently suffer from forgetfulness; and the best method of meeting this dilemma is the institution of a permanent Fund, for it is indubitable that the great majority would willingly save the trouble of continually receiving and answering circulars by paying a definite sum per annum through their bankers.

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Major Baker Brown calculates that a *pro rata* annual subscription of:—

	s.	d.
Lieutenants (other than those under instruction at the S.M.E.)	5	0
Captains	7	6
Field Officers	10	0

would produce £200 per annum if half the officers on the active list subscribed; probably, however, three-quarters of the active list would contribute, and the retired list might make up the total to £400.

Taking the Games Fund as a basis, an all-round annual subscription of 10s. 0d. each would produce £460.

Either of the totals named would permit of one minor memorial each year; but the maximum contribution to any one memorial from the permanent Fund should be fixed permanently by a resolution at a Corps Meeting.

It would be the duty of the Committee, on the decease of a distinguished officer or the close of a campaign, to consider (1) whether a memorial was required, (2) the nature of the memorial, if any, and (3) the proportion of the cost to be provided from the permanent Fund; and to submit their proposals to the next Corps Meeting. In the case of large memorials, costing more than the maximum grant permissible from the permanent Fund, it would be necessary to obtain the balance by circularising the Corps as is done at present.

Recapitulation of Proposals.

There already exists a Fund called the Memorials Maintenance Fund, which "is established for the purpose of keeping the memorials of the Corps in a proper state of repair. It receives the unexpended balances of all memorial funds and is administered by the R.E. Institute Committee." I quote from the Rules of the Institute, which also contain a list of the memorials erected by the Corps. This Fund in addition administers the trusts of the Fowke, Durand, Haynes, Armstrong and Montgomerie Memorial medals and prizes; and the annual report and accounts are included in those of the Institute. It has twice made up deficiencies in subscriptions to meet the cost of Corps memorials.

It is now proposed that:—

(1). The "Memorials Maintenance Fund" be in future called the "Memorials Fund."

(2). That the "Memorials Fund" be administered by a committee called the "Memorials Committee," consisting of:—

The A.A.G., R.E.
The C.R.E. Aldershot Command. } *Ex-officio.*
The Commandant, S.M.E.
Two officers elected at a Corps Meeting.
The Secretary, R.E. Institute.—*Secretary.*

Three members to form a *quorum.*

The Committee to have the power, in the case of any important memorial, of increasing their numbers temporarily by election at a Corps Meeting or by co-option.

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(3). That investments of balances be held in the names of Trustees elected at a Corps Meeting.

(4). That the "Memorials Fund" be raised by voluntary annual subscriptions of 10s. 0d. each per annum from all officers of the Corps, past and present.

(5). That this Fund be used for the partial (or whole) purchase, institution or construction of new memorials of campaigns or of distinguished officers of the Corps, and for the maintenance of existing memorials (except portraits). Every memorial, unless there be good reasons to the contrary, to be an addition to the permanent scheme to be decided upon at a Corps Meeting.

(6). That on the decease of a distinguished officer or the close of a campaign, the Committee consider in what manner the officer or campaign should be commemorated, and refer their recommendations to the next Corps Meeting.

(7). That the maximum amount to be expended from the Memorials Fund in furtherance of any one memorial be £400; and that any balance required be obtained by special invitation from officers of the Corps, whether subscribers to the Fund or not.

(8). That the annual report of the Committee, with a statement of receipts and expenditure, a balance sheet, and a complete list of memorials (showing their locality) be printed and circulated with the reports and accounts of other Corps Funds.

A. T. MOORE,
Major, R.E.

Station News.

QUETTA.

FALLING leaves and a falling temperature warn us that "active operations" in this part of the world must soon cease. Before we retire into winter quarters we look back upon the doings of the past autumn and summer and think that perhaps some old resident of Quetta may be interested to hear what has happened here this year. There is not, however, any long list of happenings to record. We are in an epoch of preparation and transition. Local enthusiasts predict that Baluchistan will be the most important Indian military District of the future; but no great change or development has yet occurred, though both seem imminent. Preparation, however, means hard work all the world over, and Quetta is no exception to the rule. Heavy snow and hard frost in the coming winter may indeed force some to taste the sweets of idleness, but no such prospect lies before the men whose office-tables are groaning under urgent demands for reports and estimates.

Much work has left little leisure for play, and yet most of us have managed to keep the *mens sana* in a *corpore sano*. Nearly every Sapper has been playing polo as opportunity offered; but we were again too few to raise a team for the September tournament. R. E. D. Goldingham

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played No. 2 for the Station, and played right well; but no other Sapper was good enough or well-enough mounted to find a place in any team.

At the beginning of the season it looked as if we should have a decent team of our own; but when T. Fraser was knocked out for three months by a spill tent-pegging and A. F. S. Hill went off with coolies to Thibet, we were reduced to three players, of whom one—O. H. B. Trenchard—was quite a beginner. G. A. F. Sanders, who played in many a tournament for the "Q.O." S. & M., has joined us now and C. A. Elliott and Hill are coming back. With their aid we hope that Corps polo will rise to a higher level here than it has attained for the last five years or so.

We have instituted a R.E. Polo Club for Baluchistan which should help our successors to play tournament-polo. At present it is only collecting funds for future use, and rules have been carefully drawn up to prevent these funds being diverted to any other object than polo.

In the racing world, R. E. Greer and Goldingham have kept our colours flying. *Auric* and *Grey Friars* are both a bit better than the average, and have done their owners well. *Jamil*, *Conceit* and *Makere* have also brought in some grist to the mill; and the gallant owners have generally been in the pigskin themselves and have ridden many a good finish.

In addition to the big meetings in May and September, we have had a succession of Saturday afternoons, with programmes specially designed to attract young owners and new ponies; and these have proved a success.

The Horse-Show this year was a great improvement on last year's first attempt. The entries were phenomenal and the class of exhibits very good indeed. The show was spread over two or three days, and proved quite a successful "social function," in addition to its other merits. *Grey Friars* was the best of our ponies and secured high honours; but Greer's *Conceit*, Goldingham's *Makere* and Fraser's *Boxer* also won ribands.

The Baluch Horse-Fair followed our Show and was quite remarkable for the number and quality of stock shown. For the first time for several years a large consignment of horses was brought in from Afghanistan. How did they get past the Ameer's frontier-posts? There were many buyers and sales were brisk. The whole of the horses required for the new Mekran Levy Corps were bought without difficulty, and plenty of Cavalry remounts had been secured before a single horse entered the Show ring.

In minor sports and games there is little to record. At lawn tennis Mrs. Greer, Greer and Roberts have been our most successful representatives. Trenchard is a leader in the hockey-world, and he has also followed up a most promising and attractive first appearance on the stage with a great success in "*The Magistrate.*"

Here, as elsewhere, Bridge claims many votaries of both sexes. A new ladies' card-room has had to be added to the Club to accommodate all the "mixed" fours, and the men's room is crowded to suffocation every evening.

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Every effort is being made to render the Club a more popular resort through the coming winter; but the inducement must be very great to make people leave their own firesides when they have once comfortably settled down to tea on a snowy evening. Weekly afternoon dances and concerts have, however, already begun with every prospect of continued success. The Library has been reorganised and now contains some quite readable books to suit every taste. A new Club Secretary has just been appointed, and new rules will soon be adopted.

We have had no manœuvres this autumn, owing to an outbreak of lymphangitis, anthrax, &c., &c., &c., throughout the District; and for the same reason Tactical examinations and field-days generally are rather *off*. One of the results of all this is that hunting has begun earlier and polo is going on later than usual; and, as very few men have enough ponies for both polo and hunting at the same time, the fields which follow the Quetta pack at present are small. The pack itself is small, too; but it contains 3½ couple of Quetta-bred pups which are shaping uncommonly well. We tried to make a large addition to our hounds from an Indian pack; but the result does not look promising and "thereby hangs a tale." Fraser continues to act as Field-Master this season.

Quetta, November, 1904.

ARMY RIFLE ASSOCIATION.

THE following prizes have been won by teams of Royal Engineers in the annual competitions of the above Association.

QUEEN VICTORIA'S CUP.

At Home.

4th, R.E. Chatham, 718 points, £8.

Abroad.

11th, R.E. Mediterranean, 719 points, £4.

DUKE OF CONNAUGHT'S CUP.

2nd, R.E. Chatham, 365 points, £6.

INTER-COMPANY MATCH.

At Home.

7th, 34th Company, R.E., 108 points, £5.

Football.

ARMY CUP.

THE second round of the Army Cup Tie (R.E.S.B. *v.* R.G.A., Shoeburyness) was played on December 19th at New Brompton Football Ground, by order of the Army Football Association; the original fixture at Shoeburyness on 7th December was not contested, owing to the referee's non-arrival, a friendly game being played instead. The ground was in excellent condition and the Gunners gave a very good game, which resulted in the R.E. winning by 2 goals to *nil*. Both goals were scored by Capt. C. B. O. Symons, R.E. The Sappers are drawn for the third round against the Sheerness R.G.A., at Chatham.

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FOOTBALL FIXTURES, 1904-5.

ASSOCIATION.

DATE.	OPPONENTS.	WHERE PLAYED.	RESULT. For.	Agt.
1904.				
September 21st	Training Battn., R.E.	Chatham	2	1
October 8th	Westminster School	Vincent Square	0	4
,, 29th	R.M.C., Sandhurst	Sandhurst	1	11
November 5th	R.M.A., Woolwich	Chatham	0	0
,, 9th	S.E. College	Chatham	5	2
,, 16th	Casuals	Chatham	4	4
,, 19th	Old Westminsters	Chatham	2	1
,, 26th	R.I.E.C., Cooper's Hill	Cooper's Hill	Scr'	hed.
December 7th	St. Bartholomew's Hos.	Chatham	1	4
,, 10th	Royal Naval College	Greenwich	Scr'	hed.
,, 17th	Middlesex Hospital	Chatham	4	1
1905.				
January 7th	Medway Football Club	Chatham		
,, 11th	Training Batt., R.E.	Chatham		
,, 18th	Emeriti	Chatham		
,, 21st	St. George's Hospital	Chatham		
,, 28th	R.I.E.C., Cooper's Hill	Chatham		
February 1st	Old Carthusians	Chatham		
,, 8th	Royal Naval College	Chatham		
,, 11th	R.M.A., Woolwich	Woolwich		
,, 18th	R.M.C., Sandhurst	Chatham		
,, 22nd	London Hospital	Chatham		
March 1st				
,, 4th	Clapham Rovers	Chatham		
,, 11th	Medway Football Club	Rochester		
,, 15th				
April 1st	Old Foresters	Chatham		

CAPT. C. B. O. SYMONS, R.E., *Captain.*
F. W. TOWNEND, R.E., *Hon. Secretary.*

RUGBY.

DATE.	OPPONENTS.	WHERE PLAYED.	RESULT. For. G.	For. T.	Agt. G	Agt. T.		Points. For.	Points. Agt.
Oct. 12th	R.N.C.	Chatham	2	0	0	3		10	9
,, 13th	Blackheath	Chatham	0	0	7	4		0	47
,, 19th	Park House	Chatham	1	2	0	1		11	3
Nov. 2nd	Civil Service	Chatham	0	1	1	2		3	11
,, 12th	Portsmouth	Portsmouth	1	0	3	1		5	18
,, 23rd	R.M.A.	Woolwich	Scratched owing to frost						
Dec. 1st	Old Tonbridgians	Chatham	Scratched						
,, 3rd	R.M.C.	Chatham	0	1	0	3		3	9
,, 10th	Hampstead Wanderers	Chatham	0	1	0	0		3	0
,, 17th	Old Blues	Chatham	0	0	0	0		0	0
Jan. 14th	1st Army Corps	Chatham							
,, 19th	Old Paulines	Chatham							
,, 21st	Cooper's Hill	Cooper's Hill							
Feb. 1st	United Services	Chatham							
,, 4th	Tonbridge School	Tonbridge							
,, 11th	1st Army Corps	Aldershot							
,, 22nd	R.N.C.	Greenwich							
Mar. 11th	R.M.A.	Chatham							
,, 18th	U.C.S. Old Boys	Chatham							
,, 25th	R.M.C.	Sandhurst							

J. O'HARA MOORE, R.E., *Captain.*
H. I. BULKELEY, R.E., *Hon. Secretary.*
C. E. COLBECK, R.E., *Hon. Treasurer.*

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HOCKEY FIXTURES, 1904-5.

DATE.	OPPONENTS.	WHERE PLAYED.	RESULT. For.	RESULT. Agt.
1904.				
October 5th	R.M.A.	Woolwich	3	5
,, 11th	R.M.L.I.	R.E. Ground	3	2
,, 15th	School of Gunnery	Chatham	0	4
,, 22nd	Folkestone	Chatham	Scr'	hed.
,, 26th	R.N.C.	Greenwich	Scr'	hed.
,, 29th	Kidbrooke I.	Away	2	1
November 1st	R.M.L.I.	R.M.L.I. Ground	3	1
,, 12th	U.S.H.C.	Chatham	1	2
,, 19th	Eltham	Chatham	0	0
,, 23rd	Aldershot Command	Aldershot	Scr'	hed.
,, 26th	Maidstone	Chatham	3	0
December 3rd	Rochester	Rochester	8	3
,, 7th	School of Gunnery	Shoeburyness	1	8
,, 14th	Woolwich Garrison	Woolwich	Scr'	hed.
1905.				
January 7th	Lessness Park	Abbey Wood		
,, 14th	Kidbrooke I.	Chatham		
,, 18th	R.N.C.	Chatham		
,, 25th				
,, 28th	Maidstone	Maidstone		
February 4th	Lessness Park	Chatham		
,, 8th	Aldershot Command	Chatham		
,, 15th	Rochester	Chatham		
,, 18th	Westgate	Westgate		
,, 25th	R.M.A.	Chatham		
March 1st	Woolwich Garrison	Chatham		
,, 8th				
,, 11th	U.S.H.C.	Sheerness		
,, 22nd				

CAPT. G. E. J. DURNFORD, R.E., *Capt.*
2ND LIEUT. G. A. P. MAXWELL, R.E., *Sec.*

Army News.

EXTRACTS FROM ARMY ORDERS, DECEMBER, 1904.

A.O. 210.—King's Regulations.—Revised Edition (Provisional).—1. His Majesty the King has been pleased to approve a revised edition of the King's Regulations and Orders for the Army, and copies will shortly be issued to all concerned.

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A.O. 214.—Regular and Auxiliary Forces—Courses of Instruction, 1905.—1. The following courses of instruction will be held during the year 1905:—

o o o o o

7. SCHOOL OF MUSKETRY, HYTHE.

Except in special circumstances, which will be left to the discretion of general officers commanding, no officer of the Regular Forces will be permitted to attend a course of instruction at Hythe until he has attained the rank of lieutenant.

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(i.). Regular Forces (including permanent staff of Auxiliary Forces, not previously qualified)—

{10th February to 10th March.
{10th March to 31st March.
{2nd May to 30th May.
{30th May to 20th June.
{2nd June to 30th June.
{30th June to 21st July.
{4th August to 1st September.
{1st September to 22nd September.
{13th October to 10th November.
{10th November to 1st December.
14th November to 12th December.

(ii.). Senior Officers. All arms. Regular Forces—

24th July to 29th July.
2nd October to 7th October.

o o o o o

9. Army Veterinary School, Aldershot.

(i.). Officers' Classes—

15th January and 15th November.

o o o o o

16. Balloon Factory, Aldershot.

Balloon Course for Regular officers commencing middle of March, lasting 6 weeks—

Detail—

Heavy batteries, Royal Garrison Artillery	4
General staff, cavalry and infantry	6

Qualifications—

1. Weight not to exceed 11 st. 7 lb.
2. Good eyesight.
3. Fair hand at military sketching.
4. Good sailor.

A.O. 220.—Revised Regulations for admission to the Royal Military Academy and the Royal Military College.—1. The following regulations have been approved, and copies will shortly be issued to all concerned:—

(*a*). Regulations respecting admission to the Royal Military Academy, Woolwich, and for first appointments therefrom to the Royal Artillery and Royal Engineers.

(*b*). Regulations respecting admission to the Royal Military College, and for first appointments therefrom to the Army.

A.O. 221.—Revised Regulations under which Commissions in the Regular Forces may be obtained by University Candidates have been approved, and copies will shortly be issued to all concerned.

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The first nominations under these regulations will be made in September, 1905.

After the competitive examination of June next, Army Order 141 (*d*) of 1899 will be cancelled.

A.O. 222 gives amendments to **Regulations for the Grant of Commissions in the Regular Forces to Officers of Militia and Imperial Yeomanry.**

TIBET MISSION.

Extracts from Despatches.

The *London Gazette* of 13th December, 1904, contained the following :—

Gazette of India, No. 1065, *of the 11th November*, 1904. The Right Honourable the Viceroy and Governor-General of India in Council is pleased to direct the publication of the following letter from the Adjutant-General in India, forwarding a despatch from Brigadier-General J. R. L. Macdonald, C.B., R.E., Commanding Tibet Mission Escort.

2. The Governor-General in Council entirely concurs with the Commander-in-Chief in India in his appreciation of the skilful manner in which Brigadier-General Macdonald has carried out the duty entrusted to him. His Excellency in Council is also fully sensible of the excellent conduct of the officers and men engaged in the operations.

o o o o o

From the Adjutant-General in India, to the Secretary to the Government of India, Military Department.—(No. 2917-A., dated Simla, the 26th October, 1904).

I am directed by the Commander-in-Chief to forward, for the information of the Government of India, the accompanying despatch from Brigadier-General J. R. L. Macdonald, C.B., R.E., describing the operations of the troops which accompanied the Mission to Tibet.

2. It will be seen from the despatch that the work which fell to the troops had to be carried out in the face of physical difficulties which subjected them to the severest hardships and privations, and these became increasingly acute as they neared their destination. Notwithstanding these difficulties, supplemented as they were by armed opposition, the undertaking was carried through in so successful a manner as to constitute it a highly creditable achievement. The Commander-in-Chief gladly takes this opportunity of placing on record publicly his approbation of the admirable arrangements made by Brigadier-General Macdonald and of the good services of the officers and of the troops through whose efforts the objects of the Mission were so successfully attained.

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From Brigadier-General J. R. L. Macdonald, C.B., R.E., Commanding Tibet Mission Force, to the Adjutant-General in India.—(No. 1532-A., dated Gyangtse, the 9th October, 1904).

I have the honour to submit this my final despatch on the operations of the Tibet Mission Escort during 1903–4, operations which had to be carried out in the face of exceptional natural and climatic difficulties.†

o o o o o

† It is hoped that the detailed account of the operations will be dealt with in a subsequent number of the *R.E. Journal*.—Edr.

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21. I attach list of the names of the officers and men whom I wish to bring to the notice of His Excellency the Commander-in-Chief.

ROYAL ENGINEERS.

Major C. H. Heycock, 12th Company, (2nd) Sappers and Miners.
Captain C. H. D. Ryder, Survey Officer.
Captain S. H. Sheppard, D.S.O., 3rd Company, (1st) Sappers and Miners.
Captain C. Elliot, Field Engineer.
Lieutenant J. A. McEnery, Assistant Field Engineer.
Naick Badri Pande, 12th Company, Sappers and Miners.
Sapper Triloke Chaube, 12th Company, Sappers and Miners.
Sapper Shazada, 3rd Company, Sappers and Miners.
Sapper Rahim Ilahi, 3rd Company, Sappers and Miners.
Subadar Bunyad Ali, 3rd Company, Sappers and Miners.

PERSONAL EQUIPMENT AND KIT FOR FIELD SERVICE.

Army Order 71 of 1904.

ROYAL ENGINEERS (ALL BRANCHES) DISMOUNTED NON-COMMISSIONED OFFICERS AND MEN, INCLUDING WARRANT OFFICERS AND NON-COMMISSIONED OFFICERS OF SUPERNUMERARY STAFF.

Method of Disposal.

Articles.	On man.	In wagon.	Remarks.
	lbs. ozs.	lbs. ozs.	
Rifle, short, with sling	8 3½		
Sword Bayonet, 1903 Pattern, with scabbard ...	1 4¾		
Belt, waist, buff, G.S., with 4 cartridge pockets ...	1 9		
Frog, buff, G.S.	0 4¾		
Ammunition, 50 rounds, on belt with chargers ...	3 7	—	50 usually; 50 more when an action is imminent, in haversack.
Haversack with—			
(*a*) Unused portion of bread or biscuit ration, say 12 ozs.	2 14½		
(*b*) Emergency ration, 12 ozs.			
(*c*) Fork and spoon, 4 ozs.			
(*d*) Tooth brush, ½ oz.			
Mess tin and cover with unused portion of meat ration, say 12 ozs.	2 3¼		
Waterbottle, filled, with carriage and strap ...	3 12		
Tin, mineral jelly, filled, pull-through and canvas cover	0 8½	—	Containing grease for rifle, feet, and boots.
Greatcoat in web carrier, with comforter cap (3½ ozs.) and 1 pair of socks (4¼ ozs.) ...	6 6		
Head dress	1 2¾		
Jacket with field dressing and description card ...	2 8½		
Trousers	2 1		
Jersey or cardigan (worn when ordered)	1 5		
Braces	0 4½		
Shirt, flannel...	1 1½		
Belt, woollen	0 4½		
Socks...	0 4¼		
Boots, ankle	3 14		
Putties	0 14½		
Clasp knife and lanyard	0 8		
Drawers	1 0½		

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Method of Disposal.—Continued.

Articles.		On man.		In wagon.		Remarks.
		lbs.	ozs.	lbs.	ozs.	
Waterproof sheet		—		2	9	If issued.
Blanket		—		4	8	
Spare Field Kit	Canvas shoes, 1 pair... ...	—		1	5	
	Bootlaces, 1 pair	—		0	0½	
	Drawers, 1 pair	—		1	0½	
	Housewife, fitted	—		0	3	
	Shirt, flannel	—		1	1½	
	Small book	—		0	2	
	Towel and soap	—		0	11½	
	Canvas bag	—		0	8	
Total		45	14¼	12	0¾	

NOTE.—The buff waistbelt will be coloured brown on mobilization.

R.E. SOUTH AFRICAN WAR MEMORIAL FUND.

SUBSCRIPTIONS acknowledged in November *Journal* £2,503 1 9

Subscriptions since received up to 20. 12. 04 inclusive :—

	£	s.	d.		£	s.	d.
*Capt. J. B. Corry	2	2	0	Capt. G. Walker	1	0	0
Capt. S. D'A. Crookshank	2	0	0	Col. F. R. de Wolski	2	0	0
Capt. G. R. Hearn	2	2	0	Capt. J. N. C. Kennedy.....	1	0	0
Lt.-Col. T. de la H. Brotherton...	0	10	0	Capt. E. H. Pym.....	0	10	0
*Col. H. Locock	5	0	0	2nd Lieut. H. L. D. Pennington	0	10	0
Major A. H. Cowie	0	10	0	Lt.-Col. L. C. Jackson	1	0	0
Lieut. H. N. North	1	8	4	Capt. J. C. Matheson	1	10	0
*Lt.-Col. C. F. Call	2	0	0	Capt. G. E. Smith	1	0	0
Capt. F. G. Turner	2	0	0	Major R. D. Petrie	2	0	0
Lieut. M. N. McLeod	1	1	0	Lt.-Col. H. D. Laffan.....	1	0	0
					£30	3	4

* Second subscriptions.

Total received up to date..... £2,533 5 1

Minimum still required to complete arch, £150.

A. T. MOORE, *Major, R.E.,*
Hon. Secretary.

20. 12. 04.

KING'S PORTRAIT FUND (R.E.).

SUBSCRIPTIONS acknowledged in December *Journal* £214 10 7

Subscriptions since received, up to 20. 12. 04 inclusive :—

At £1.—Lt.-Gens. Sir W. G. Nicholson, C. Pollard £2 0 0

At 10s.—Maj.-Gen. W. H. Edgcome, Col. W. D. Marsh, Capts. H. F. E. Freeland, M. B. H. O'Donel, Lieuts. E. B. Cardew, O. E. U. Ingham £3 0 0

At 7s. 6d.—Brig.-Gen. H. P. Leach, Cols. R. C. Hellard, W. J. MacKenzie, T. R. Main, Sir E. T. Thackeray, R. Thompson, G. F. Wilson, Lt.-Cols. P. R. Burn-Murdoch, W. F. Hawkins, H. L. C. H. Stafford.....£3 15 0

At 5s. 8d.—Lieut. M. N. McLeod 5 8

At 5s.—Lt.-Col. F. F. Cotton, Majors E. M. Burton, G. H. Harrison, G. M. Hutton, G. Le Breton-Simmons, W. J. McElhinny, C. C. J. Pery, A. R. Reynolds, Capts. G. A. Beazeley, R. J. Done, H. L. Crosthwait, W. H. Jones, R. F. Knox, W. C. Macfie, A. A. McHarg, J. C. Matheson, C. H. H. Nugent, G.E. Smith, A. H. Tyler, Lieuts. P. R. Bald, T. T. Behrens, F. S. G. Piggott, E. Rogers £5 15 0

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At 2s. 6d.—Lieuts. J. S. Barker, H. J. Couchman, P. H. Kealy, C. St. J. Lynch, C. H. Palmer, A. G. Rainsford-Hannay, T. H. Tennent, B. H. Wilbraham £1 0 0

Total.....£15 15 8

Total received to date £230 6 3

A. T. MOORE, *Major, R.E.*,
Hon. Secretary.

20. 12. 04.

It was estimated that, if two-thirds of the past and present Officers of the Corps subscribed the amounts suggested in the circular asking for contributions, the total sum received would be £282.

The amount required for the painting for the Headquarter Mess is £260. Each additional £10 will allow of the purchase of an artist's proof engraving for one of the messes at Aldershot, Roorkee, Pretoria, etc.

PERSONAL NOTES.

CAPT. SIR RALPH ANSTRUTHER, BT., late R.E., has been appointed one of the three Royal Commissioners to enquire into matters connected with the dispute between the Free Church and the United Free Church of Scotland.

MAJOR E. H. HILLS, C.M.G., R.E., has been selected as the Conservative candidate in the next election at Portsmouth.

CAPT. C. B. O. Symons, R.E., has been playing centre forward for the Army Association football team.

AN officer writes as follows :—

I think it would be generally interesting if the new *Supplement* to the *R.E. Journal* contained news of R.E. officers who distinguish themselves in sport otherwise than purely regimental (such as county cricket matches, international or county football matches, amateur championship racquets, etc.), in science (*e.g.*, Geographical Society medals, researches in electricity, mechanical inventions) and in art, letters, or diplomacy.

This information has now to be gleaned by odds and ends from the daily newspapers, or from journals that deal with science, art, letters, or exploration.

The Editor already does his best to supply such information, by publishing under the heading of "Personal Notes" what he sees in the newspapers. But the newswriters in the papers frequently omit to give the initials of gentlemen they mention; and it is generally difficult, without much correspondence, to ascertain whether the persons referred to are R.E. Officers. The Editor would be glad of assistance in collecting news.

Births.

DICKSON.—On the 15th October, 1904, at Roorkee, India, the wife of Captain W. E. R. DICKSON, Royal Engineers, of a son (Eric Percy).

NORRIS.—On Sunday, the 11th December, 1904, at Notabile, Malta, the wife of Major NORRIS of a son.

Marriages.

GREEN—ISITT.—On the 6th December, 1904, at St. Margarets's Church, Rochester, by the Rev. W. K. Wilson, M.A., Vicar, Captain A. F. U. GREEN, Royal Artillery, only son of Colonel A. O. GREEN, Royal Engineers, of Camberley, to ALICE, youngest daughter of J. T. and C. R. ISITT, Rochester, Kent.

STEWART—HUNTER.—On the 14th December, 1904, at Karachi, India, Major FRANCIS THORNTON STEWART, 45th Regiment (Sikhs), son of the late Lieutenant-General STEWART, Royal Engineers (Bengal), to MURIEL CONSTANCE, youngest daughter of Lieutenant-Colonel J. MUIR HUNTER, C.S.I., Indian Army.

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WALTON—MORTON.—On the 12th October, 1904, at St. Peter's, Eaton Square, by the Rev. W. J. Earle, Rector of Great Yeldham, Essex (uncle of the bridegroom), assisted by the Rev. A. P. Cornwall, ex-Vicar of Barnham (cousin of the bridegroom), Major ELLYS W. WALTON, Royal Engineers, son of the late General BENDYSHE WALTON, Bengal Staff Corps, to GRACE GEORGINA, daughter of the late Surgeon-Major EDWARD MORTON, 2nd Beloochis, and granddaughter of the late Blaney Leslie, Nutfield, county Fermanagh, Ireland.

Deaths.

DICKSON.—On the 20th October, 1904, at Roorkee, India, EDITH SOPHIA, dearly-loved and deeply-mourned wife of Captain W. E. R. DICKSON, Royal Engineers (daughter of the late Brigade-Surgeon G. E. WHITTON).

HILL.—On the 18th December, 1904, at 53, Oxford Terrace, Hyde Park, SYBELLA HILL, eldest daughter of the late Colonel PHILLPOTTS, Royal Engineers, widow of Major-General Sir WILLIAM HILL, K.C.S.I.

HILLIARD.—On the 29th October, 1904, at Kasauli, after three days' illness, Major WILLIAM ROBERT HILLIARD, Royal Engineers, aged 43 years.

McCAUSLAND.—On the 25th December, 1904, at Mauritius, Lieutenant MARCUS ECKLEY McCAUSLAND, Royal Engineers, the much-loved youngest son of Colonel M. F. H. McCAUSLAND, R.A., aged 23 years.

TYLEE.—On the 1st January, 1905, at The Grove, Cheltenham, LOUISA, widow of the late THOMAS PILKINGTON TYLEE, and second daughter of the late Major-General PILKINGTON, Inspector-General of Fortifications, aged 92.

VICARS.—On the 27th November, 1904, the First Sunday in Advent, at 59, Cambridge Terrace, Hyde Park, ANNIE ELIZABETH, widow of Major-General EDWARD VICARS, late Royal Engineers, in her 81st year.

Corps News.

The following appointments have been approved:—

Major and Brevet Lieutenant-Colonel G. M. Kirkpatrick from Deputy-Assistant Quartermaster-General, Canada, to be Deputy-Assistant Quartermaster-General in the Office of the Director of Military Operations at Headquarters.

Captain P. T. Denis de Vitrè to be Adjutant to the 2nd Cheshire, Royal Engineers (Volunteers).

Lieutenant A. E. Davidson to be Assistant Instructor in Electricity at the School of Military Engineering, Chatham, in succession to Captain A. D. Carden, who is about to vacate that appointment.

Movements at Home.

Brevet Colonel J. G. Day from leave to Jersey.

Lieutenant-Colonel P. R. Burn-Murdoch from leave to Pembroke Dock.

Lieutenant-Colonel C. D. Learoyd from Weedon to York.

Brevet Lieutenant-Colonel G. M. Kirkpatrick, on arrival home from Canada, to the War Office, London.

Brevet Lieutenant-Colonel Sir E. P. C. Girouard, K.C.M.G., D.S.O., from leave from South Africa to London.

Major R. U. H. Buckland from leave from Gibraltar to Shorncliffe.

Captain E. S. Sandys from Chatham to Aldershot.

Captain L. St. V. Rose from the School of Military Engineering, Chatham, to Cork, for duty on the Ordnance Survey.

Captain J. J. Galloway, on arrival home from Gibraltar, to Norwich.

Lieutenant F. B. Legh from leave to the School of Military Engineering, Chatham.

Lieutenant G. C. Williams, on arrival home from Bermuda, to Colchester.

Lieutenant W. J. W. Noble, on arrival home from Jamaica, to Landguard Fort, Felixstowe.

Lieutenant H. E. F. Rathbone, on arrival home from Bermuda, to Gravesend.

Lieutenant A. B. Cunningham, on arrival home from Malta, to the School of Military Engineering, Chatham.

Arrivals.

From Bermuda.—Lieutenants H. E. F. Rathbone and G. C. Williams.

From Canada.—Brevet Lieutenant-Colonel G. M. Kirkpatrick.

From China.—Captain E. W. S. Mahon.

From Gibraltar.—Captain J. J. Galloway.

From Gold Coast.—Lieutenant A. E. Coningham.

From India.—Lieutenant-Colonel W. Huskisson, on leave of absence. Lieutenant A. J. Ross, on sick leave of absence.

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From Jamaica.—Lieutenant W. J. W. Noble.
From Malta.—Lieutenant A. B. Cunningham.
From Somaliland.—Lieutenants K. E. Edgeworth, H. G. Gandy and F. R. P. O'Callaghan.
From South Africa.—Brevet Lieutenant-Colonel R. S. Curtis, D.S.O., on leave of absence. Captain D. S. MacInnes, D.S.O.

Embarkations.

For Egypt.—Brevet Major E. V. Turner, for duty with the Egyptian Army.
For India.—Colonel C. C. Ellis, Majors W. R. Morton, A. J. H. Swiney and F. F. Weedon and Captain W. A. S. Kincaid, on expiration of leave of absence.
Lieutenant-Colonel T. A. Cregan, Lieutenants T. H. L. Spaight, B. C. Battye and D. K. Edgar, for a tour of service.
For Mauritius.—Lieutenant J. A. Langman.
For South Africa.—Majors F. V. Jeffreys, J. de C. Laffan and Captain G. Dick.
Captain C. W. Davy, on expiration of leave.
The 54th (Field) Company, under the command of Major B. E. Morony, with Lieutenant W. Ommanney.
The 55th (Field) Company, under the command of Captain H. W. Weekes, with Lieutenant A. H. Du Boulay.
The 58th (Field) Company, under the command of Lieutenant P. O. L. Jordan.

Extracts from the London Gazette.

War Office, Pall Mall, S.W., November 25, 1904.

MEMORANDUM.—Lieutenant-Colonel and Brevet Colonel John C. L. Campbell, half-pay, Royal Engineers, retires on retired pay.—Dated November 26, 1904.

ROYAL ENGINEERS (MILITIA).—*Royal Monmouthshire.*—Major C. H. Paynter is granted the honorary rank of Lieutenant-Colonel.—Dated November 26, 1904.

ROYAL ENGINEERS (VOLUNTEERS).—*1st Cheshire.*—Captain J. L. McLean is seconded whilst holding the appointment of Instructor of Musketry.—Dated November 26, 1904.

2nd Cheshire (Railway).—Lieutenant W. F. Black to be Captain.—Dated November 26, 1904.

1st Northamptonshire.—Captain J. S. Ellis is granted the honorary rank of Major.—Dated November 26, 1904.

ROYAL ENGINEERS (VOLUNTEERS) SUBMARINE MINERS.—*The Severn Division.*—Lieutenant H. M. Jacob resigns his Commission.—Dated November 26, 1904.

War Office, Pall Mall, S.W., December 2, 1904.

ROYAL ENGINEERS.—Captain Howard A. D. Fraser to be Major, vice J. Winn, promoted.—Dated November 15, 1904.

STAFF.—Major and Brevet Lieutenant-Colonel G. M. Kirkpatrick, Royal Engineers, from Deputy-Assistant Quartermaster-General, Canada, to be a Deputy-Assistant Quartermaster-General at Headquarters, vice Colonel C. E. Callwell, appointed an Assistant Director.—Dated November 21, 1904.

ROYAL ENGINEERS (MILITIA).—*Royal Monmouthshire.*—Major C. M. Crompton-Roberts is granted the honorary rank of Lieutenant-Colonel.—Dated December 3, 1904.

ROYAL ENGINEERS (MILITIA) SUBMARINE MINERS.—*The Needles Division.*—Captain F. L. Donaldson is granted the honorary rank of Major.—Dated December 3, 1904.

ROYAL ENGINEERS (VOLUNTEERS).—*1st Aberdeenshire.*—Lieutenant-Colonel W. S. Gill is granted the honorary rank of Colonel.—Dated December 3, 1904.

2nd Gloucestershire (the Bristol).—The undermentioned Officers resign their Commissions:—

Captain T. M. Allison.—Dated December 3, 1904.
Lieutenant H. P. Raban.—Dated December 3, 1904.

1st Sussex.—The Reverend W. A. Carr to be Acting Chaplain.—Dated December 3, 1904.

War Office, Pall Mall, S.W., December 6, 1904.

BREVET.—Captain and Brevet Major Sir E. P. C. Girouard, K.C.M.G., D.S.O., Royal Engineers, to be Lieutenant-Colonel, for distinguished services of an exceptional nature other than in the Field, under the provisions of Article 36, Royal Warrant, October 26th, 1900.—Dated November 7, 1904.

War Office, Pall Mall, S.W., December 9, 1904.

ROYAL ENGINEERS (MILITIA).—*Royal Monmouthshire.*—Humphrey Mackworth, Gent. (late Lieutenant, 3rd Battalion The Queen's (Royal West Surrey Regiment)), to be Lieutenant.—Dated December 10, 1904

ROYAL ENGINEERS (MILITIA) SUBMARINE MINERS.—*The Falmouth Division.*—Second Lieutenant H. G. Hooper resigns his Commission.—Dated December 10, 1904.

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ROYAL ENGINEERS (VOLUNTEERS).—*1st Aberdeenshire.*—Captain J. B. Miller is granted the honorary rank of Major.—Dated December 10, 1904.

1st Hampshire.—Stephen Flowers, Gent., to be Second Lieutenant (Supernumerary).—Dated December 10, 1904.

1st Lancashire.—Major J. R. Burrows is granted the honorary rank of Lieutenant-Colonel.—Dated December 10, 1904.

2nd Lancashire (the St. Helens).—Quartermaster C. Anders is granted the honorary rank of Captain.—Dated December 10, 1904.

1st Middlesex.—Captain S. D. Sewell is granted the honorary rank of Major.—Dated December 10, 1904.

Lieutenant W. H. Anstie is transferred to the Cadet Corps (Tonbridge School), attached.—Dated December 10, 1904.

Lieutenant G. Parker resigns his Commission.—Dated December 10, 1904.

Cadet Corps (Tonbridge School) attached to 1st Middlesex.—Lieutenant W. H. Anstie to be Captain.—Dated December 10, 1904.

ROYAL ENGINEERS (VOLUNTEERS) SUBMARINE MINERS.—*The Severn Division.*—Second Lieutenant C. R. Corfield resigns his Commission.—Dated December 10, 1904.

War Office, Pall Mall, S.W., December 13, 1904.

ROYAL ENGINEERS.—Brevet Colonel Waldemar D. Lindley, on completion of five years' service as a regimental Lieutenant-Colonel, is placed on half-pay.—Dated December 10, 1904.

Lieutenant-Colonel Godfrey H. W. Stockdale is placed on half-pay on account of ill-health.—Dated November 4, 1904.

The promotion of the undermentioned Officers is antedated as follows:—

Lieutenant-Colonel John Winn to November 4th, 1904, vice G. H. W. Stockdale.

Major Howard A. D. Fraser to October 30th, 1904, vice W. R. Hilliard, deceased.

Lieutenant-Colonel John Winn retires on retired pay.—Dated December 14, 1904.

Major Sidney G. Burrard to be Lieutenant-Colonel, vice Brevet Colonel W. D. Conner, placed on half-pay.—Dated November 15, 1904.

Captain Charles B. Collins to be Major, vice J. Winn.—Dated November 4, 1904.

MEMORANDA.—Colonel James Cameron, on vacating the appointment of Colonel on the Staff, Commanding Royal Engineer, Malta, is placed on half-pay.—Dated November 15, 1904.

The undermentioned Assistant Directors of Fortifications and Works at Headquarters are granted the substantive rank of Colonel in the Army.—Dated April 1, 1904:—

Brevet Colonel William J. MacKenzie.
Brevet Colonel Frederick Rainsford-Hannay, from Royal Engineers.
Brevet Colonel Stewart D. Cleeve, from Royal Engineers.

War Office, Pall Mall, S.W., December 16, 1904.

THE KING has also been graciously pleased to give orders for the following appointments to the Distinguished Service Order, and promotions in the Army, in recognition of the services of the undermentioned Officers with the Tibet Mission Escort. The promotions to bear date of November 10th, 1904:—

BREVET.—To be Majors:—

* * * * *

Captain Seymour Hulbert Sheppard, D.S.O., Royal Engineers.

* * * * *

India Office, S.W., December 16, 1904.

THE KING has been graciously pleased to make the following promotions in, and appointments to, the Most Eminent Order of the Indian Empire, in recognition of the services of the undermentioned in connection with the Tibet Mission:—

To be Knights Commanders.

* * * * *

Major and Brevet Colonel James Ronald Leslie Macdonald, C.B., Royal Engineers, in command of the Escort.

War Office, Pall Mall, S.W., December 16, 1904.

CORPS OF ROYAL ENGINEERS.—Brevet Colonel Edward H. Bethell, D.S.O., on completion of five years' service as a Regimental Lieutenant-Colonel, is placed on half-pay.—Dated December 15, 1904.

Lieutenant Edward G. Wace to be Adjutant of the Training Battalion, vice Captain H. W. Weekes, whose tenure of that appointment has expired.—Dated November 10, 1904.

MEMORANDA.—Lieutenant-Colonel and Brevet Colonel Charles K. Wood, half-pay, Royal Engineers, retires on retired pay.—Dated December 17, 1904.

The date of promotion to the substantive rank of Colonel of Brevet Colonel Stewart D. Cleeve, from Royal Engineers, is May 20th, 1904, and not as stated in the *Gazette* of December 13th, 1904.

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ROYAL ENGINEERS (VOLUNTEERS).—*1st Gloucestershire.*—Captain C. A. Apperly resigns his Commission.—Dated December 17, 1904.

2nd Gloucestershire (the Bristol).—Charles Lowther O'Shee Bilderbeck, Gent., to be Second Lieutenant.—Dated December 17, 1904.

3rd Lancashire.—Lieutenant E. M. Duggan resigns his Commission.—Dated December 17, 1904.

War Office, Pall Mall, S.W., December 20, 1904.

MEMORANDUM.—Lieutenant-Colonel and Brevet Colonel William D. Conner, half-pay, Royal Engineers, retires upon retired pay.—Dated December 21, 1904.

Extracts from the Indian Gazette.

GOVERNMENT OF INDIA.

CIVIL.

November 5th, 1904.

Hume, Capt. A. H. B., dept. supt , 2nd grade, is granted special leave for 3 m., from Dec. 5.

November 12th, 1904.

The following notifications are made in the dept. of Revenue and Agriculture :—

Kelly, Col. F. H., assist. adj.-gen., Quetta dist., is placed on deputation as member of Indian Survey Committee, from Nov. 15

Longe, Lieut.-Col. F. B., surveyor-gen. of India, is placed on deputation as member of Indian Survey Committee, from Nov. 9.

The following prom. of exec. eng. att. to State Railways is made from date specified :—

Rose, Major C. S., 2nd grade, to 1st grade, permanent, Sept. 23.

The following notification is made in Survey of India :—

Beazeley, Capt. G. A., dep. supt., 2nd grade, reverted to Survey of India, from July 21.

November 19th, 1904.

The following notification is made in Public Works Dept. :—

Thomas, Lieut. R. H., offieg. assist. supt., 1st grade, Survey of India, is granted special leave for 2 m., from Jan. 1, 1905.

November 26th, 1904.

The following have passed prescribed tests in Pushtu, Higher Standard, at exam. held at Peshawur, Dera Ismail Khan, Bannu, and Meean Meer, on Oct. 31st and following days : —

Loch, Lieut. G. C. B. | Young, Lieut. E. de L.
Winsloe, Capt. H. E.

Hopkins, Capt. L. E., exec. eng., 3rd grade, servs. are placed at disp. of Govt. of India, Public Works Dept., on completion of work on Shiliman Railway Survey by end of November.

MILITARY.

INDIAN ARMY ORDERS.

October 24th, 1904.

Chaldecott, Capt. W. H., passed prescribed test on Aug. 9, and is technically qualified for promotion to rank of capt.

The undermen. officers of Royal Engineers are posted to comds. specified : —

Arkwright, Lieut.-Col. L. A., Bengal comd.
Russell, Major W., Madras comd.

November 7th, 1904.

Ogilvie, Capt. D., is posted to Punjab comd.
Stockley, Capt. H. R., is posted to Punjab comd.

November 26th, 1904.

Campbell, Capt. H. B. D., is appd. capt., Mussoorie Volunteer Rifles, from Oct. 21.

PUNJAB.

LIEUT.-GOVERNOR'S ORDERS.

November 10th, 1904.

The following notification is made in Public Works Dept. : —

Crookshank, Capt. A. A., assist. eng., is posted to Ambala Provincial div., which he joined on Oct. 26.

COMMAND ORDERS.

November 10th, 1904.

The undermen. has passed exam. in Oriental Language stated : —

Pushtu, Lower Standard.

Lieut. E. C. Baker.

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November 17th, 1904.

Smith, Lieut. V. P., is transf. from 1st (Peshawur) div to Derajat Brig., and Sopwith, 2nd Lieut. G. E., from Derajat Brig. to 1st (Peshawur) div.

November 24th, 1904.

The following are granted leave out of India on priv. affs. : -

Skinner, Lieut. R. B., Military Works Services, for 1 year.

BENGAL GOVERNMENT.

MILITARY.

COMMAND ORDERS.

November 3rd, 1904.

Glanville, Major F., D.S.O., on arrival in India, is posted to Allahabad dist. as Comdg. Royal Eng.

Haswell, Lieut. C. H., on transfer from Sappers and Miners, is posted to Meerut dist.

The undermen. officer is granted leave out of India :—

Ross, Lieut. A. J., 1st Sappers and Miners, 6 m., on med. cert.

November 10th, 1904.

The undermen. officer has qualified at exams. for tactical fitness for comd. : —

Browne, Brevet Lieut.-Col. C. A. R., Royal Eng.

November 17th, 1904.

Sanders, Lieut. A. R. C., company officer, 1st Sappers and Miners, is appd. company comdr., dated Nov. 2.

November 24th, 1904.

The undermen. officers have passed exams. specified :—

Urdu, Higher Standard.

Charles, Capt. J. R. E., D.S.O., 1st Sappers and Miners.

Elles, Lieut. H. J., 1st Sappers and Miners.

Urdu, Lower Standard.

Porter, Lieut. M. T., Indian Submarine Mining Corps.

Malan, Lieut. L. N., on return from Thibet, is posted to Meerut dist.

Giles, Lieut. V., on return from Thibet, is posted to Meerut dist.

MADRAS GOVERNMENT.

CIVIL.

November 22nd, 1904.

Love, Colonel H. D., principal, College of Engineering, is granted exten. of furl. for 4 weeks.

MILITARY.

COMMAND ORDERS.

November 8th, 1904.

The undermen. officer has passed in language and test specified :—

Oakes, 2nd Lieut. G. F. T., Lower Standard, Urdu.

November 15th, 1904.

White, Capt. J. R., is appd. company comdr., 2nd Queen's Own Sappers and Miners, dated Oct. 25.

BOMBAY GOVERNMENT.

MILITARY.

COMMAND ORDERS.

November 4th, 1904.

The undermen. officer is perm. to return to duty :—

Arbuthnot, Lieut. A. D. S., 3rd Sappers and Miners.

November 11th, 1904.

Barnes, 2nd Lieut. L. E., on arrival in India, is posted to Quetta div., for employ. under Comdg. Royal Eng., Kurrachee Brigade.

Kemp, Capt. G. C., is transf. from Bombay Brigade to office of Chief Eng., Western Army Corps, Military Works Service.

November 18th, 1904.

On return from Thibet the following officers are posted to Quetta div., for employ. under Comdg. Royal Eng., Quetta :—

Elliott, Capt. C. A. | Hodgson, Capt. P. E.

Hill, Lieut. A. F. S.

BURMA.

November 12th, 1904.

Kincaid, Capt. W. A. S., agent, Burma Railways, 2nd class, 1st grade Superior Revenue Estab. of State Railways, has been granted furl. for 1 m., on med. cert., in ext.

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CENTRAL PROVINCES.

November 26th, 1904.

Pollard-Lowsley, Lieut. H. de L., assist. eng., 2nd grade, on being relieved, is appd. to charge of Weinganga Irrigation div., from Nov. 14.

ARRIVALS REPORTED IN LONDON.

Huskisson, Lieut.-Col. W. | Magniac, Capt. A. L.
Bovet, Capt. W.

EXTENSIONS OF LEAVE.

Money-Shewan, Major R. E., 1 mo. | Moore, Capt. H. O'H., 3 mo.

PERMITTED TO RETURN.

Crookshank, Capt. S. D'A. | Sanders, Lieut. A. R. C.
Huskisson, Lieut.-Col. W.

Notices.

LECTURES AT THE S.M.E., CHATHAM.

LECTURES to be delivered at the Royal Engineers Institute during the Spring of 1905, to commence at 5.30 p.m. :—

DATE.	LECTURER.	SUBJECT.
Thurs., Jan. 19th	Capt. A. B. Carey, R.E.	Rifle Ranges.
Thurs., ,, 26th	Lieut. W. R. Napier, R.N.	Booms.
Thurs., Feb. 2nd	Capt. E. Lees, R.N.	Submarine Boats.
Thurs., ,, 9th	A. R. Hinks, Esq., M.A.	Recent Measurements of the Sun's Distance.
Thurs., ,, 16th	H. V. Weisse, Esq.....	Colour Photography.
Thurs., ,, 23rd	Colonel L. A. Hale, R.E., *ret.*...	Modern War in Relation to Home Defence.
Thurs., March 2nd	Lieut.-Colonel R. C. B. Haking, Hampshire Regt., *p.s.c.*	The Application of the Principles of Tactics.
Thurs., ,, 23rd	Lieut.-Colonel Sir E. P. C. Girouard, K.C.M.G., D.S.O., R.E.	Railways in War.

DETAILED HISTORY OF THE RAILWAYS IN THE SOUTH AFRICAN WAR, 1899—1902.

THE two volumes of the Institute publication are now ready, and will be despatched during the month to those Members who registered their names in response to the circular of 15th October, 1903.

NOTES FOR OFFICERS PROCEEDING TO INDIA.

JUST published. 8vo. 150 pages, with map, bound with stiff sides. Price to Members 2s. ; to non-Members 2s. 6d.

BOOKS FOR PROMOTION EXAMINATIONS.

As letters are frequently received by the Secretary, R.E. Institute, asking for information as to the books required for Promotion Examinations, attention is drawn to the loose sheet issued with the *R.E. Journal* for the first month of each quarter; on this full particulars, price, etc., are given of the Institute and S.M.E. publications and of the subjects, and books required, for the various Promotion Examinations.

ADDRESSES OF MEMBERS.

OFFICERS who do not receive their *R.E. Journal* and Institute publications are requested to make early intimation to the Secretary.

The Secretary, R.E. Institute, would be much obliged if full-pay Officers proceeding on long leave (*especially from abroad*), and retired Officers who change their places of residence, would send *early notification* to him of the addresses to which they desire their copies to be sent.

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Such notifications should be sent as early as possible, as considerable inconvenience is caused monthly by changes of address not being received until the *Journals* are addressed and even despatched.

R.E. CORPS LIBRARIES.—EXTRACTS FROM RULES.

RULE 4.—All Officers of the Corps may be members of the Corps Libraries.

RULE 6.—Officers on the unemployed or half-pay lists cease to be subscribers unless they give notice to the Secretary of their wish to subscribe.

RULE 5.—Retired Officers are allowed to resume their membership on payment of subscription for the current year.

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BYE-LAW 1.—Indian Officers, while at home on furlough, etc., may subscribe at 5s. per quarter instead of for a year.

RULE 9.—Subscriptions to the Corps Libraries shall be paid on January 1st in each year. Officers who may wish to become members between July 1st and January 1st shall pay only half the amount of the subscription for the current year.

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Any Officer may propose new books for the London Library at any time. (*Name of publisher and price should be given when possible*).

RULE 12.—The London Library will be kept supplied with all the most recent works connected with the Art of War, Civil Engineering, Architecture, and Physical Science; while works of History, Travels, Biography, and Science and Art generally will be added as funds permit. The Home Stations Libraries will be supplied only with books of reference and works that are likely to be useful in the performance of ordinary duties. The Foreign Stations Libraries will be kept well supplied with professional works.

R.E. MONTHLY LIST.

C.R.Es. are requested to draw the Editor's attention to any errors that may be noticed in the "Station Lists," pages xxiv. to xxx.

R.E. BAND CONCERTS.

THERE will be Band Concerts in the Mess, Chatham, on Mondays, 13th February and 13th March, 1905, at 3.30 p.m. Officers are requested to furnish the Mess Secretary with names and addresses of friends they wish to invite.

R.E. CHARITABLE FUND.

COMMUNICATIONS to the Secretary of this Fund should be addressed to "*The Secretary, R.E. Charitable Fund, c/o D.F.W., War Office, Whitehall, S.W.*" No letters affecting this Fund should be sent to Chatham.

The telegraphic address of the Secretary, R.E. Institute, and Editor, *R.E. Journal*, is **SAPPER, CHATHAM.**

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THE ROYAL ENGINEERS JOURNAL.

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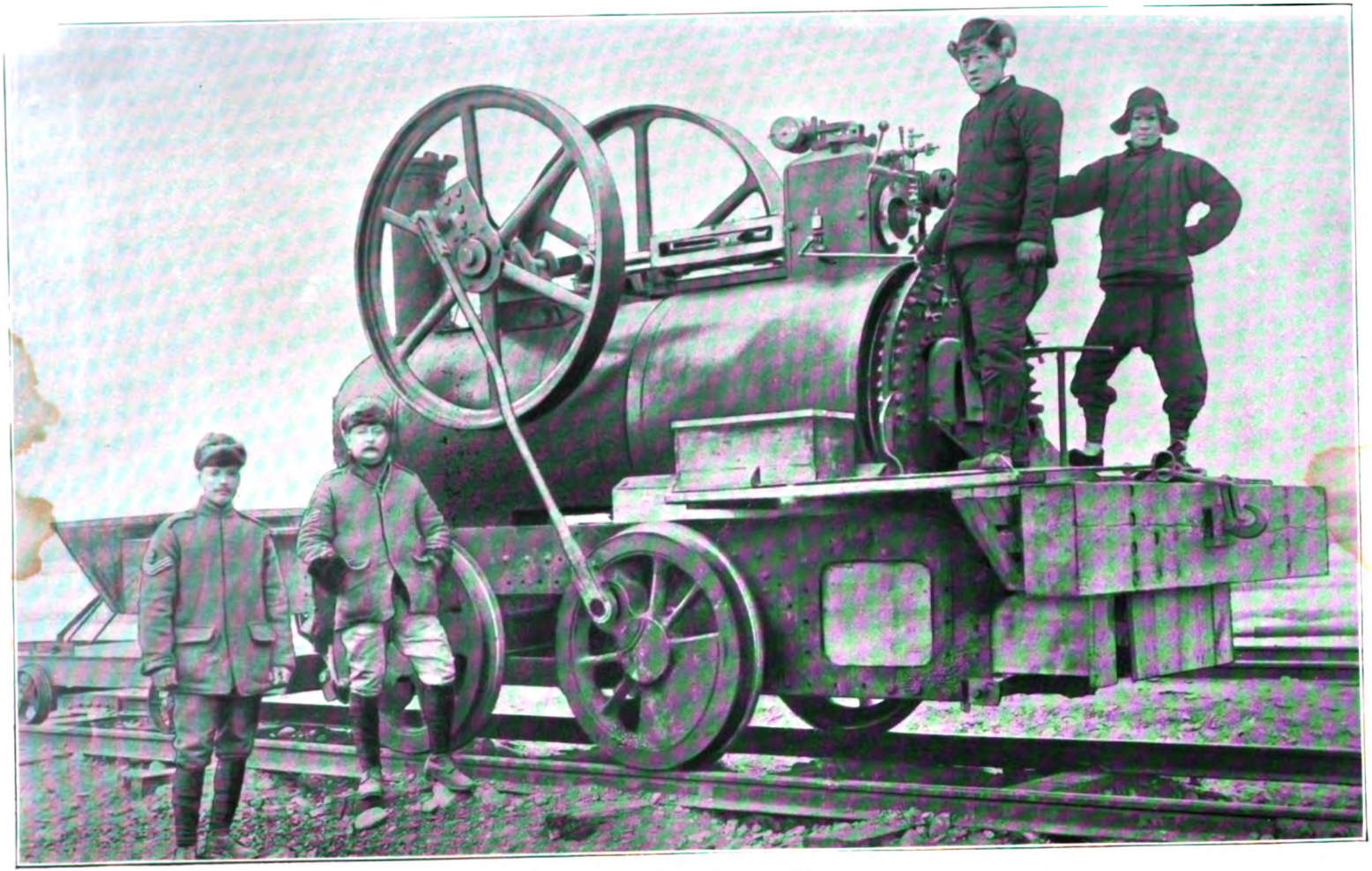

"THE GRASSHOPPER."

China Expedition, 1900.

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"*THE GRASSHOPPER.*"

AN IMPROVISED LOCOMOTIVE IN THE CHINA EXPEDITION, 1900.

THE frontispiece of this number of the *R.E. Journal* shows a locomotive which was improvised during the operations about Pekin in December, 1900. It was constructed by No. 4 Company of the Bengal Sappers and Miners (Capt. H. R. Stockley, R.E.), under the supervision of Sergeant (now Q.M. Sergeant) A. Tinkham, R.E., of that famous Corps.

The frame and wheels were taken from the remains of locomotives destroyed by Boxers at Fangtai Junction. No lifting gear was available; and in order to suit the frame to the superstructure, a length of 6 feet had to be cut off with chisels and a large "Jim Crow," and a wooden buffer plank put on.

The engine was an old stationary single-cylinder one, originally used for driving a dynamo at the Imperial Palace near Pekin. It was mounted on the shortened frame and secured by bolts, while coupling rods were attached to the flywheels on each side. These rods were made from long truss bars, taken out of damaged bogie carriages at Fangtai and "bushed-up" with copper piping for the bearings; they lasted very well. In the absence of reversing gear, the crank of the eccentric coupling had to be shifted with a spanner whenever the engine went backwards. No steam gauge was available.

Notwithstanding these drawbacks the respectable speed of 12 miles an hour was attained with a load of three 20-ton cars. At first the motion was found to be very shaky, but steadiness was obtained by fixing counter-balances on the flywheels. Owing to its ungainly appearance the engine was christened "The Grasshopper."

This novel locomotive worked successfully for 3 months on the sidings at Pekin; after which the engine was taken off its frame and sent to Tientsin, where it did useful work in pumping water.

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THE BATTLE OF THE YALU.

FROM 22ND APRIL, 1904, TO 1ST MAY, 1904.

By BT.-COLONEL J. D. FULLERTON, R.E.

I. DESCRIPTION OF THE BATTLEFIELD.
II. THE OPPOSING FORCES AND THEIR DISPOSITIONS.
III. NARRATIVE OF EVENTS.
IV. COMMENTS.

I. DESCRIPTION OF THE BATTLEFIELD.

Extent.—The battlefield extends along both sides of the R. Yalu, from Antung, the right flank of the Russian position, to the village of Su-ku-chin, which marked the Russian left flank.

Rivers.—R. Yalu.—The main feature is the R. Yalu, the passage of which was the Japanese object. The river itself is broad, shallow, and full of muddy, sandy flats or islands, the position and size of which vary considerably according to the time of year and the height of the tide, which at ordinary times has a rise and fall of some 8 ft. at the town of Wiju. At Su-ku-chin the stream (a single one) is about 250 yards wide; at the point where it is joined by the River Ai the breadth increases to about 2½ miles, while a little below Wiju it is about 3½ miles. The principal islands are Chiu-li-tao lying between Won-hwa-tong on the Korean side and Husan Hill; Chin-ting-tao, opposite Wiju, and stretching some miles down the river, and Chang-chaing-tai, an island about 4 miles long, also opposite Wiju, running some mile and a half up the River Ai. All these islands are more or less cultivated and have many small villages and huts on them.

The depth of the river is very variable; at Wiju the centre of the three streams into which it is divided requires bridging, but the other two can be forded, the depths being about 3 ft. At Antung the depth is about 10 ft., but bridges were found necessary at Su-ku-chin, between Chiu-li-tao and Husan, and between Chin-ting-tao and Chang-chaing-tai Islands. The water in the river was low, and generally favourable for the passage of troops.

R. Ai.—The R. Ai runs into the Yalu, a little above Wiju, and is very similar in character to the latter. It has a soft bottom, with a

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depth of from 3 ft. to 5 ft. according to the time of the year, but the depth varies greatly, and careful reconnaissance is necessary, to find out the best crossing places.

Hills.—The country generally is hilly, the right or Manchurian bank of the river as a rule commanding the Korean side. Between the R. Ai and Yalu the country is very rough, the hills having steep slopes, unsuitable for any artillery but mountain batteries. From Antung to Chiu-lien-cheng, and along the right bank of the R. Ai, the hills vary in height from 100 to 200 ft., while further back, N.W. of Chiu-lien-cheng, a height of 300 ft. is attained. Husan at its highest point, about 7 miles N. of Wiju, is about 1,000 ft. high, and commands the Makan and Yu-shu-kon range on the left bank of the Ai. The high ground N. of Li-tzu-yuan rises to a height of 300 ft. The S. bank of the R. Yalu is low lying, being seldom more than 150 ft. high (100 ft. at Wiju) within a couple of miles of the river bank.

Roads.—The roads in the area are few, the principal one being the main Mandarin road through Wiju, Chiu-lien-cheng, and Hohmatung to Feng-whang-chang and Liao-yang. The other routes are little more than paths leading from village to village, and like the Mandarin road, are very rough, and unsuitable for anything but light traffic.

Towns.—The principal towns and villages are Wiju (20,000); Antung, the right of the Russian position, and Chiu-lien-cheng, its centre. There are small villages at Su-ku-chin, Li-tzu-yuan, Husan, and on the islands.

Weather.—The weather for a week before the battle was fine, and suitable for military operations. A heavy mist on the morning of the 30th April prevented the Japanese Artillery opening fire till 10 a.m.

II. THE OPPOSING FORCES AND THEIR DISPOSITIONS.

A. THE RUSSIAN FORCE.

The Russian troops were on 22nd April holding the line of the R. Yalu on the N. side from Antung to Su-ku-chin, disposed as follows :—

In command--General Sassouiitch, Commanding II. Siberian A.C.

Right Wing	... Antung and neighbourhood.	...	9th E. Sib. Rifle Regt. 10th E. Sib. R. Regt. 24th E. Sib. R. Regt. (1 battalion). No. 1 Battery, III. E. Sib. Art.

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Centre	Chiu-lien-cheng with detachments about Husan.	...	12th E. Sib. R. Regt. No. 1 Battery, VI. E. Sib. Art. No. 1 M.G. Company
Left Wing ...	W. of R. Ai		22nd E. Sib. R. Regt.
	Makau		No. 2 Battery, VI. E. Sib. Art.
	Yu-shu-ku		No. 3 Battery, VI. E. Sib. Art.
Reserve ...	Hohmatung		11th E. Sib. R. Regt. No. 3 Battery, III. E. Sib. Art.
Cavalry ...	Guarding both flanks	...	Cossack Cavalry Brigade (3 regts.), Major-Gen. Mistchenko.

Total Strength: 17 battalions, 5 batteries, 1 M.G. Company and 3 regiments cavalry. About 14,000 men, 40 guns, and 8 M.G.

General Sassoulitch's Headquarters were at Antung; Major-General Kashtalinsky commanded the centre and left wing.

Very little was done in the way of entrenching the position, the earthworks constructed being, especially on the left flank, of a very simple character.

The object of General Kouropatkin, the C.-in-C. of the Russian Army, in holding the R. Yalu position was to gain time for the concentration of his troops at Liao-yang. His orders to General Sassoulitch were to check the advance of the Japanese, watch their movements, hold them for a time, but not to seriously engage a superior force.

General Sassoulitch's plan of operations was to hold the line of the R. Yalu as a defensive position and prevent the enemy crossing. He appears to have thought that the Japanese would attack his centre and right flank, partly because the country on the left of his position was not very suitable for manœuvring large bodies of troops, and partly owing to false information obtained by him which led him to believe that the Japanese were concentrating at Wiju, and preparing to cross some distance below the town.

B. THE JAPANESE FORCES.

On 22nd April, 1904, the Japanese Forces were holding the S. bank of the R. Yalu from Yongampho (12 miles S.W. of Wiju) to Suku-chin, and were disposed as follows:—

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(*a*). *Military Forces.*

In command—General Kuroki, Commanding the I. Imperial Japanese Army.

Right Wing ...	Won-hwa-tong to Su-ku-chin. ...	XII. Division (Lt.-Gen. Inoue).	
		12th Brigade	14th Regt. 47th Regt.
		23rd Brigade	24th Regt. 48th Regt.
Centre	About Wiju	Imperial Guard Division (Lt.-Gen. Hasegawa).	
		1st Brigade	1st Regt. 2nd Regt.
		2nd Brigade	3rd Regt. 4th Regt.
Left Wing ...	S. of Wiju	II. Division (Lt.-General Nishi).	
		3rd Brigade	4th Regt. 29th Regt.
		15th Brigade	16th Regt. 30th Regt.

Each Division had 6 batteries of artillery, and there was a special artillery force of 20 heavy (probably 5-inch) guns.

The Cavalry Brigade consisted of 3 regiments.

The total strength was: 48 battalions, 108 field guns, 20 heavy guns, and 1,800 cavalry, or about 45,000 men with 128 guns.

(*b*). *Naval Forces.*

In command—Commander Nakagawa, I.J. Navy.

Left	Between Yongampho and Antung. ...	Gunboat *Uji*. Gunboat *Maya*. T.B.'s—two. Armed launches—three.

The Japanese positions all along the river were very carefully entrenched; all the routes along which troops were to move were concealed by artificial hedges, screens, etc., and it was extremely difficult not only for the Russians to see the positions from their side of the river, but also for spies, etc., examining the ground to ascertain the real strength and dispositions of the troops.

General Kuroki's object was to force the passage of the R. Yalu, and he attached considerable importance to this action, not only on account of the results to be obtained by a successful crossing, but

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also because this first encounter between Japanese and European troops would, if successful, considerably increase the confidence of his men in their powers of meeting the Russian forces in the future. The plan of operations was very simple. The whole line of the river was to be strongly held, and numerous demonstrations made to mislead the enemy; then when all was ready, a direct attack was to be carried on the centre by two divisions, combined with an attack on the enemy's left flank by the other Division.

III.—NARRATIVE OF OPERATIONS.

22nd April.—The Japanese completed the concentration of their troops about Wiju, and commenced carefully reconnoitring the enemy's position. At the same time arrangements for concealing their own positions, by erecting screens, to cover guns, lines of advance of troops, etc., were undertaken.

The Russians also carried out reconnoitring expeditions. On this date their information regarding the enemy was that a concentration was in progress about Wiju and that smaller bodies were moving up stream. It was evident to the Russians that an attempt would be made to cross at Wiju with the main force, while a flank attack either below or above Wiju would also probably be attempted at the same time.

23rd April.—Reconnoitring and general preparations were continued by both forces.

24th April.—The result of the Japanese reconnaissances showed that the Russians held the whole length of the W. bank of the R. Yalu, from Su-ku-chin to Antung, with small parties concealed near the riverside. The naval flotilla, after exploring the lower reaches of the river, reported that small boats could get up to the neighbourhood of Antung.

25th April.—The Russian reconnaissances had not up to this date been very successful; no patrols had succeeded in reaching the E. bank of the R. Yalu. The opinion of the Russian Commander was that an attempt would be made to cross below Wiju, and all his preparations were based upon this idea.

26th April.—In the early morning the Japanese flotilla proceeded up stream, and had an engagement with some Russian cavalry near Antung, while later on, about 5 p.m., there was some further skirmishing in this neighbourhood. At about 4 a.m. a detachment of the Imperial Guard, 250 strong, attacked the enemy on Chiu-li-tao Island, some 150 strong. After a hot fight the Russians retired in some disorder to the right bank of the R. Yalu, setting fire to the village before retreating. The firing of the village was a signal for a heavy fire from the batteries N. of Chiu-lien-cheng, but the Japanese pushed on and occupied the place, with a loss of 9 killed and

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32 wounded. The Russian losses amounted to 1 officer and about 30 men. While the above action was in progress a detachment from the II. Japanese Division occupied Chin-ting-tao Island without loss.

About 12 noon the Russian batteries N. of Chiu-lien-cheng opened fire on Wiju and the village Soho-tong to the W. of the town, but the Japanese did not reply, the fire being ineffective.

During the day the Japanese succeeded in bridging the E. branch of the R. Yalu (the first channel) about 3 miles below Wiju, but further bridging operations could not be carried out owing to the heavy fire from the batteries N.E. of Chiu-lien-cheng.

27th April.—The Russians commenced entrenching their positions along the W. bank of the R. Ai, the operations being plainly visible to the Japanese.

During the day the Russian batteries N.E. of Chiu-lien-cheng kept up a heavy fire in order to persuade the Japanese guns to answer and disclose their positions, but the Japanese batteries did not reply.

The Guards and II. Division sent further detachments to reinforce the troops which had obtained possession of Chiu-li-tao and Chin-ting-tao Islands. A detachment of the II. Division occupied Chang-chaing-tai Island.

A company of the Japanese guards moved across to Husan in the early morning, but after a skirmish with a small Russian detachment about Li-tzu-yuan, had to retire on Chiu-li-tao Island with a loss of 10 men, as the Russians were reinforced by a battalion with 3 guns.

28th April.—Two Companies of the Japanese Imperial Guard, 4th Regiment, occupied Husan, and reconnoitred towards Li-tzu-yuan, driving out a small Russian detachment some 30 strong, which retired across the R. Ai with a loss of 5 killed. Later in the day 2 battalions of 4th Regiment, with some mountain guns, occupied Li-tzu-yuan, and held it during the night of 28th—29th. The Russians again opened a desultory fire against the Japanese in the islands and about Wiju, but this was not replied to. The general orders for the final attack of the Russian positions were issued this day, as follows :—

XII. Division to march to Su-ku-chin (on the R. Yalu, about 8 miles N. of Wiju), cross the river on the 29th April and by midnight on 30th April to be on the hills E. of the R. Ai, on the line Li-tzu-yuan—Tchingou (opposite to). Objective in the final attack, the extreme N. Russian defences, and to prevent retreat of Russians from Chiu-lien-cheng.

Guards Division to cross to Husan, and by midnight on 30th to hold the line Li-tzu-yuan—Husan. Objective in the final attack, the Makau Hill and pursuit of enemy.

II. Division to cross to Chang-chaing-tai Island, and by midnight 30th April to be ready to cross the R. Ai. Objective in the final attack, the hill N.E. of Chiu-lien-cheng ; then to move down stream towards Antung.

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Artillery distributed as follows :—

XII. Division...	With the Division.
Imperial Guard Division	E. of Wiju and on Chiu-li-tao, heavy artillery ; field batteries on N. Chin-ting-tao.
II. Division	S. Chin-ting-tao.
Reserves...	Wiju ; to advance along the Wiju—Chiu-lien-cheng road as the action developed.

Artillery bombardment to commence at 5.30 a.m. on 1st May, 1904 ; the infantry attack by all Divisions to commence at 7.30 a.m. Divisional Engineers to construct the necessary bridges.

29th April.—In the early morning a Russian detachment under Lieut.-Colonel Linde attacked the Japanese forces at Li-tzu-yuan and compelled them to withdraw, some to Chiu-li-tao and some to the N.

A detachment of XII. Japanese Division (2 battalions and 2 batteries) crossed at Su-ku-chin, driving back a weak Russian detachment under Lieut.-Colonel Gouser. A bridge was commenced at that place 2 p.m.

The Russian batteries continued their bombardment of Wiju and the islands.

The Imperial Guard and II. Divisions continued bridge making and moving guns on to the islands.

The Japanese Naval Flotilla moved up stream from its base at Yongampho, and had small engagements with the Russian scouts during the day.

30th April.—From 10 a.m. to 6 p.m. the Japanese kept up a heavy bombardment of the Russian position with all the available heavy and field guns, to cover the movements of their troops.

The Imperial Guards crossed to Husan, and by the evening had driven the Russian detachment holding Li-tzu-yuan across the R. Ai.

The II. Division completed its crossing to the islands, and took up a position which was only separated rom the right bank of the R. Yalu by a narrow stream.

The XII. Division continued its crossing at Su-ku-chin, and by night time had occupied the Tchingou (opposite to)—Li-tzu-yuan position, outflanking the Russian left. Some of the Japanese troops on the extreme right crossed the R. Ai during the night, and were by early morning in rear of the Russian left.

Major-General Kashtalinsky, who commanded the Russian left wing, viz., from Chiu-lien-cheng to Tchingou, reported to General Sassoulitch, commanding the Russian forces, about 5 p.m. that an attack on the left flank seemed probable ; but he received a direct order to accept battle on the positions he then held.

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The Japanese Naval Flotilla again proceeded up stream to reconnoitre, and had a brisk engagement with about 400 Russian cavalry a little S. of Antung.

By midnight, 30th April, the whole of the Japanese troops were in their allotted positions.

May 1st.—5.30 *a.m.*—*The Artillery Bombardment.*—At sunrise the Japanese Artillery opened a very heavy fire on the Russian positions all along the line.

7 *a.m.*—By 7 a.m. the whole of the Russian guns had been silenced and the Russian infantry outposts driven from the river bank. The objectives of the artillery fire were: II. Division and Imperial Guard, the hills N. of Chin-lien-cheng and Makan Hill; XII. Division, Yu-shu-kou and Li-tzu-kou.

7.30 *a.m.*—*The Infantry Advance till 12 noon.*—At 7.30 a.m. the infantry attack commenced. The objectives were: XII. Division, Yu-shu-kou and left flank of Russian position; Imperial Guards Division, Makou and hills to the S.; II. Division, Chiu-lien-cheng and hills to the N. The infantry attack formation was successive lines of skirmishers, the distance from man to man being about 6 paces. The losses were not great considering the strong positions attacked, the greatest losses being suffered when the men had to close in to cross the fords.

About 9 a.m. the Japanese succeeded in occupying the whole position from Chiu-lien-cheng to Tchingou. The Russians held out gallantly for a considerable time, but owing to the fact that the reserves were at such a long distance in rear (about 3 miles) a retirement became absolutely necessary. The troops commenced to retreat in good order towards a position about 1½ miles E. of Hohmatung, across the Chin-lien-cheng—Hohmatung road.

After capturing the heights the Japanese advanced as follows:—XII. Division, towards Tai-tou-fung and Hohmatung; Imperial Guard Division, on Hohmatung direct; II. Division, by hills to W. of Chin-lien-cheng, on Hohmatung. Reserves along the Chin-lien-cheng—Hohmatung road.

1 *p.m.*—*Arrival of Russian Reserves.*—About 1 p.m. two battalions of the 11th Regiment and a battery, which the Russians had up till now held in reserve, came up with instructions sent by General Sassoulitch to hold out till the 9th and 10th Regiments from Antung (which had not hitherto been engaged) could come to the assistance of the left wing. The 11th Regiment and the battery were ordered by Major-General Kashtalinsky to take up the position above alluded to and cover the retirement of the rest of his troops. The Russians made many charges, and fairly well maintained their position till about 2 p.m.

2 *p.m.*—*Final Retirement and Surrender of Russian Troops at Hohmatung.*—About this time the Russians at Hohmatung were in a

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desperate position. Three advanced companies of the Japanese 23rd Brigade, XII. Division, had got well round their left rear, and although these had lost nearly half their strength, they managed to prevent the retreat of the Russian Hohmatung troops. Other Japanese troops began to close in, and soon the Russians were enveloped on three sides. They made desperate but unsuccessful charges, and finally, after having suffered considerable loss, they surrendered at 6 p.m.

6 *p.m.*—The remains of the Russian force retreated along the Feng-whang-chang road.

After the battle was over the Japanese occupied the line Antung—Hohmatung—Tai-tou-fung—the R. Ai. While the action was in progress the Japanese Naval Flotilla assisted by engaging the enemy in the neighbourhood of Antung. It suffered no losses.

The Japanese losses were 5 officers and 218 rank and file killed, 33 officers and 783 rank and file wounded.

The Russian losses were, according to General Kouropatkin's report, 7th May, 1904, 26 officers and 564 rank and file killed, 40 officers and 1,082 rank and file wounded, 7 officers and 670 rank and file missing; but the Japanese state that they buried 1,363 of all ranks after the battle and took 613 prisoners.

The Russians also lost 21 3-inch Q.F. guns and 8 machine guns.

IV. COMMENTS.

1. *The Russian Plan of Operations.*—The orders issued by General Kouropatkin were suitable for the occasion. His great object was to gain time to collect his troops at Liao-yang, and consequently a course of action on the R. Yalu, which allowed of checking the enemy temporarily without incurring serious loss, was exactly what was required. General Sassoulitch does not appear to have quite realized this, and seems to have thought that the defeat of the Japanese on the R. Yalu was the principal object of the operations. As regards his actual plan for the defence of the position, it cannot be said to be a very satisfactory one. The troops were almost all extended along the banks of the river, the only reserve being some three miles in rear of the centre of the position, with very rough and broken country to cross if it became necessary to reinforce the flanks. The calculation also that the right flank would be attacked was unfortunate, as many indications showed that the Japanese intended to operate against the left flank.

It is only fair to say, however, that the position was not such a strong one as it might at first sight appear. There was no good secondary position in rear of the main one; Husan Hill and the high ground to the N.W. commanded all the country within artillery range, and the Rivers Ai and Yalu, though formidable obstacles,

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could, as far as their W. streams were concerned, be forded fairly easily.

There is, however, little doubt that the well-established principle of holding the river bank lightly, keeping the bulk of the force in hand at some convenient position and either falling on the enemy while in the act of crossing or promptly retiring, leaving strong rear guards to inflict as much loss as possible without becoming seriously engaged, would have given better results.

As regards Major-General Kashtalinsky's defence of the left wing of the position, it should be noted that he was directly ordered to maintain his position, and no blame can therefore be attached to him for his share in the defence.

2. *The Japanese Plan of Operations.*—The general plan was remarkably good, and extremely well carried out. Two objections have been made to it, first that the outflanking movement on the Russian left flank was not carried far enough, and second that the II. Japanese Army, the greater part of which was in transports off the mouth of the R. Yalu, should have been employed to make an attack on the Russian line of communications with Liao-yang, from the W.

As regards the first objection, it should be noted that the XII. Division crossed the R. Ai on a front of about 4 miles, and that considering it was attacking locally strong positions, viz., the hills about Yu-shu-kou and to the N. of that place, this extension was as much as could be safely made. In the actual advance after the hills were taken the 23rd Brigade did march on Hohmatung, and the capture of the Russian guns and defeat of a large number of infantry ensued. But it is doubtful whether an advance to the W. of the Tchingou—Hohmatung road would have been safe, and the very difficult nature of the country, quite unsuited for cavalry action, would probably have rendered such an extended advance abortive. Next as regards the employment of the II. Japanese Army. General Kuroki had some 45,000 men, and he no doubt felt that he had quite sufficient troops to deal with the Russian Forces, and as his superiority in strength was about three to one, the employment of the II. Army hardly seemed necessary. Again, the Japanese were naturally enough particularly anxious to isolate Port Arthur, and intended to use the II. Army for that purpose. Had the troops been landed at the mouth of the R. Yalu and moved as suggested, considerable delay in acting against Port Arthur would have ensued, and it is also possible that the Russians might have withdrawn from the line of the R. Yalu altogether, a result certainly not desired by the Japanese, who were particularly anxious to give their troops an opportunity of encountering their enemy.

Taking it as a whole the general plan of attack was skilfully arranged, and reflects great credit on the Japanese Commander.

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3. *Intelligence and Reconnaissance Duties.*—The Russian Intelligence Service does not appear to have been very well carried out, chiefly, no doubt, on account of the difficulty always experienced in obtaining information in a country the population of which is hostile to the army operating in it. The Russian Commander ought by the morning of the 29th April to have known that a movement in force against his left flank was in progress, but he does not seem to have received any really reliable information on this subject till the afternoon of that day, when he received Major-General Kashtalinsky's report. In the same way the precarious state of the left wing positions on 1st May was not known apparently to General Sassoulitch at Antung till about 10 a.m., and consequently both the Reserves and the troops of the right wing arrived too late to be of much assistance to Major-General Kashtalinsky.

The Japanese Intelligence Department was most carefully organized and skilfully worked. Very complete information as to the strength of the enemy, the best points for crossing the river, etc., was obtained, and the work done by this branch of the service was most satisfactory.

4. *Artillery.*—Owing to the great preponderance of the Japanese artillery (128 guns to 40) it is difficult to estimate the values of the respective artillery services. But there is no doubt that the Japanese artillery was splendidly served in every way, and that its fire, especially on the 1st May, was most effective. The Russian guns had of course little or no chance against such a large force, but they were well fought as far as circumstances permitted.

5. *Engineers.*—The Japanese engineering operations were most skilfully carried out, especially the bridging of the rivers, and the concealment of the gun positions and routes of approach to the river bank. It must however be recollected that there was ample time to construct these works, which might not always be the case in attacks of this description. The Russian entrenchments were as a rule of a very slight character. With the time at General Sassoulitch's disposal (at least three weeks) much better works should have been constructed, but he probably was so confident of holding his position that he considered a better class of defence unnecessary.

As regards the telegraph service, that of the Japanese appears to have been remarkably complete. All the Headquarters of Divisions, brigades and even of smaller units were connected with Army Headquarters by a telephone service, and the Commander of the Army was thus able to keep in complete touch with his subordinates, and knew exactly what was going on all over the area of the battlefield.

The Russians do not appear to have had a telegraph detachment with them. It was noticed by the Japanese that messages were constantly sent by mounted officers and orderlies, and it is probably

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due to this that so much delay ensued in bringing up the reserves on 1st May.

6. *Infantry.*—The Japanese infantry attack, although carried out in much closer order than our S. African experience would consider suitable, was effected with remarkably little loss, the whole of the casualties being only about 1,000 out of some 45,000 men, 350 of which occurred among the 3 companies which checked the Russian retirement at Hohmatung. This result was no doubt partly due to the artillery fire, but the turning movement on the Russian left flank appears to have been the real cause of the very effective assault.

The Russian infantry was so outnumbered that it is difficult to estimate its proper value, but there can be no doubt that the officers and men showed great courage under very trying circumstances, and that in the final charges everything that brave men could do was done.

NOTE.—The plan is reproduced from the *Voennyi Sboenik* by the kind permission of the Imperial Russian Authorities. As most of the places have different names in Russian, Chinese, and Japanese, the names which appear to be most commonly used in the different accounts of the battle have been inserted in the plan.

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LANGUAGES IN INDIA.

By COLONEL J. E. BROADBENT, C.B., LATE R.E.

IN the last Census it was found impracticable to take any language census in the greater part of Baluchistan, British Afghanistan, Swat, Kohistan, Chitral, Hunza-Nagar, etc., and in certain wild hill-tracks in Burma. But without these no less than 147 distinct languages were recorded as vernacular in the Indian Empire; of these 147 the Indo-Chinese family accounts for 92, found in the Himalayas, Burma and North-East India.

The languages of India proper belong to two great families, denominated in the census report The Drāvido-Mūnda Family and the Indo-European Family, Aryan Sub-family.

The *Drāvido-Mūnda family* of languages are those of the ancient inhabitants of India. They have no affinity in construction or vocabulary with Sanskrit. They belong to the "agglutinating" type (Cases, etc., formed by the addition of suffixes). They are divided into the Mūnda sub-family and the Drāvidian sub-family. The former includes Santāli, Kol, and other languages spoken by about 3,180,000 people in the north-east of the central plateau of India—the hills of the Santal *pergannahs*, Chota Nagpur, Orissa, Chattisgarh, and North-East Madras; they have no written character of their own.—The latter comprises Tamil, Malayālam Kanarese, Telugu (each of which has its own distinctive though allied written character), and a number of others of less importance, among which may be mentioned Gond and (strange to say) Brahui; these languages are spoken by more than 56½ millions, being the speech, broadly speaking, of the south of the Indian Peninsula. Tamil is the best known and most cultivated; Telugu is the most wide-spread and the most euphonious, and has been called the Italian of the East.

The *Aryan sub-family* has two branches, the Eranian and the Indo-Aryan. The former includes Baluch and Pashtu (the latter written in an adapted Arab-Persian character), which are spoken by about 1,380,000 people. The latter includes;—(*a*) several languages spoken in the mountainous region north and west of Kashmir—Gilgit, Chitral, Kafiristan—which, though clearly Indo-Aryan, appear to have been developed independently of Sanskrit; and (*b*) the Sanskritic Indo-Aryan languages—Hindi, Bengāli, Bihāri, Oriya, Panjābi, Gujerāti, Marāthi, Kashmiri, Sindhi (each with a different written

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character, but most of them akin to Deva-nagari) and others,—spoken by nearly 220,000,000 people.

The original home of the Indo-European populations (now spread over Europe and parts of Western and Southern Asia) was perhaps in the Steppe-country of Southern Russia. One division of this people wandered westwards and became the parents of the Greek, Latin, Keltic and Teutonic races. Another wandered to the east, and from their language descended the speech-families which we call Aryan, Armenian, etc., (four others). The first only of these concerns India.

The Aryans, at first a people of one language, again subdivided; after the separation the once common Aryan speech developed on two different lines, becoming the parent on the one hand of the Eranian (often spelt Iranian) and on the other of the Indo-Aryan family of languages.

At the earliest period for which there is documentary evidence Eranian was divided into two not very different languages, Persic and Medic. The oldest form of Persic is found in one of the versions of the inscription of Darius I. (B.C. 522—486) at Behistun; from this through Middle Persian, or Pāhlavi, was developed modern Persian. The one literary monument which remains of ancient Medic is the *Avesta;* there is no mediæval Medic; but the modern Eranian languages of India, viz.:—Pushtu, Baluch, etc., were developed from it.

The earliest specimens ot actual Indo-Aryan vernaculars are to be found in the hymns of the *Rig Veda*. They were composed at widely different periods and in far-apart localities; most of them were originally in the actual spoken language of their authors. They were edited by the Brāhmans, who compiled them into one collection so as to obscure dialectical peculiarities; but they nevertheless furnish invaluable evidence as to the house-language of the earliest inhabitants of India.

The term *Prākrit, prākrita*, has for centuries been used to denote the vernacular language,—the natural, unartificial language, as opposed to Sanskrit, *samskrita*, the polished artificial language. The vernacular dialects of the Vedic hymns were, in this sense, essentially Prākrit, and may be called the Primary Prākrit of India. Existing inscriptions and writings show that, by the 3rd century B.C., an Aryan speech in several dialects, which had developed from the ancient vernaculars, was in use in Northern India; parallel with this, the so-called classical Sanskrit had developed from one of those dialects, and under the influence of the Brahmans had achieved a position similar to that of Latin in the middle ages. The edicts of Asoka were written in the former of these, and, further, it was used by the Buddhists for their sacred scriptures; as thus crystallized and fixed it is known as the Pāli language. But as a vernacular it continued to develop, and in its

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later stages, in various dialects, it is what the term Prākrit is commonly used to denote. These dialects in turn were used for poetic, religious and dramatic works, so becoming fixed; and finally they also became a dead language (about 1000 A.D., as a very approximate date). The true vernaculars still continued to develop and eventually gave us the languages of the present day.

Classical *Sanskrit*, derived from one of the primary Prākrit dialects, was early fixed by the labours of grammarians, culminating in the grammar of Pānini about 300 B.C. It borrowed freely from the secondary Prākrits, and they from it. Regarded as a sacred language, and as such jealously preserved by the Brahmans in their schools, it had all the prestige which religion and learning could give it. It is usually written in the Deva-nagari character. For many hundred years classical Sanskrit has been exercising, and still exercises, a potent influence on the vocabularies of the modern vernaculars; but *only* on the vocabularies, for their grammars show no trace of it. Literary Bengali and Hindi are filled with Sanskrit words; it has been proved by actual count that in a modern Bengali work 88 per cent. of the words were pure Sanskrit, every one of which was unnecessary.

There is not space to discuss the modern languages in detail; but a few words may be said about *Hindustani*. As a vernacular it is classed in the Census Report as a dialect of Western Hindi. But it is better known as the literary language of Hindustan and the *lingua franca* current over nearly the whole of India; to Europeans it is the polite speech of India generally. As a *lingua franca* it grew up in the bazar attached to the Delhi Court, and was carried everywhere by the lieutenants of the Moghal Empire. It has several recognized varieties, Urdu, Rekhta, Dakhini and Hindi (that is the Hindi of the *Prem Sagar*).

Urdu is that form of Hindustani which is written in the Persian character; it makes a free use of Persian (including Arabic) in its vocabulary. Rekhta is the form it takes when used in poetry. Dakhini is the form of Hindustani used by Musalmans in the Deccan; it is written in the Persian character like Urdu, but is not so Persianized.

The *Hindi* variety of Hindustani is the prose literary language of those Hindus who do not employ Urdu. It was introduced at the commencement of last century, when Lallu Ram, under the inspiration of Dr. Gilchrist, wrote the *Prem Sagar;* the prose parts of this work are practically written in Urdu, but with Indo-Aryan words used wherever a writer of Urdu would have used Persian words. This language fulfilled a want by giving the Hindus a *lingua franca* free from the (to them) unclean words of the Musalmans, and it has held its place to the present day. It is written in Deva-nagari character.

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External Languages.—In addition the following languages may be noted:—(1) *Persian;* this is spoken by all the upper class Muhammadans and is in Western Asia what French is in Europe, the language of culture and diplomacy; it has an extensive and interesting literature; and it is worth learning on both accounts, though it is nowhere a vernacular in India. (2) *Arabic,* the most common of Eastern languages, and knowledge of which facilitates the learning of others. (3) *Turkī,* the language of Turkestan, which may be found more useful than Russian in a possible theatre of war.

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ELECTRIC DEVELOPMENT AT NIAGARA FALLS.

By LIEUT. E. D. CARR-HARRIS, R.E.

WHILE on leave in Canada during last summer I paid a visit to Niagara Falls and went over some of the new electrical works which are in course of construction on the Canadian side of the river.

Some very large electrical developments are in progress, of which the following notes may prove of general interest.

Three separate Companies, entirely independent of each other, are now at work. These are the Ontario Power Company, the Toronto and Niagara Power Company, and the Canadian Niagara Power Company.

THE ONTARIO COMPANY.

The first of these, which began its work nearly two years ago, hopes to have its generating station in use within the course of the next four or five months.

This generating station is built on a rocky plateau or shelf at the foot of the Falls and only a few feet above the level of the water. It will develop 50,000 H.P. when completed.

The intake is some distance above the Falls. Two long steel flumes, circular in section, 18 feet in diameter, and 6,600 feet long, lead the water from the point of intake near Dufferin Island. They follow very nearly the surface of the ground along the river's bank until they reach a point beyond the crest of the Falls and vertically above the generating station; here the water is led into a vertical stand pipe, at the bottom of which are placed large turbine wheels. The water passes down the vertical stand pipes and out through the turbine wheels, which, by means of shafting, transmit the power to the dynamos; it is then discharged back into the river again, but below the Falls.

THE TORONTO AND NIAGARA COMPANY.

The method followed by this Company is the reverse of that adopted by the Ontario Company in that the generating station is at the intake end.

Turbines are placed at the bottom of a wheel pit, which is being sunk at Tempest Point, about half a mile above the Horse-shoe Fall. This pit is to be 40 feet by 200 feet in cross section and deep enough to give 164 feet head of water to the turbines. After passing through the turbine wheels the water will enter a tunnel, which leads away under the bed of the river, and ultimately discharge at the foot of the Falls.

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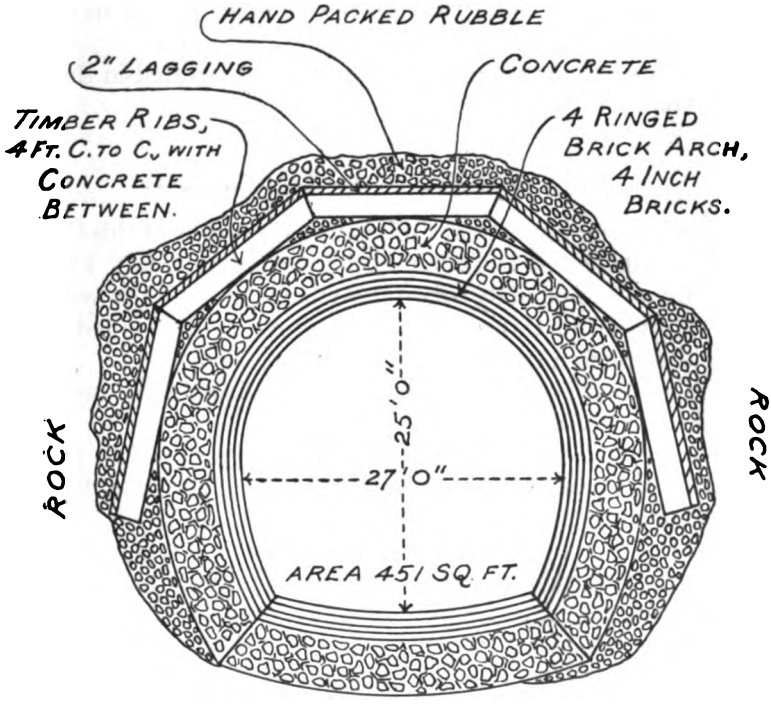
When I visited the site, in company with one of the engineers, work was in progress at both ends of the tunnel, and the pit was being sunk at the upstream end, within 100 yards of the river's edge; when the latter is completed a passage will be opened out in order to admit the water.

As the whole of the work is in rock, heavy blasting is necessary and a large number of compressed air drills are in use. When excavating for the wheel pit a water seam was crossed. This was only stopped, after various experiments had been tried, by running in cement grouting under 50 feet head of pressure.

Eleven turbine wheels are to be placed in line at the bottom of the wheel pit, each turbine capable of developing 10,000 H.P.

The power house will be built over the mouth of the pit and will contain the dynamos and electric appliances.



CROSS SECTION OF TUNNEL

(Not to Scale)

The tunnel was begun from the down stream end. At a point on the river bank in line with the Horse-shoe Fall a workmen's shaft was first sunk, from the bottom of which a gallery was run out, at

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right angles to the course of the river, to a point about mid stream; from here the main tunnel was begun at a level only a few feet above that of the water under the Falls. To save labour in getting rid of the rock excavated from the main tunnel, an opening has been broken out through the face of the fall, and all the débris is now discharged through this into the river. When I visited the work the tunnel had been cut for a distance of about 1,000 feet upstream from the point of discharge. Its cross sectional area will be 451 square feet and its dimensions roughly 27 feet by 25 feet; the total length will be 2,700 feet. From the above particulars some idea of the boldness of the scheme may be obtained.

The labour employed is principally Italian. Compressed air drills have been found most useful, and are entirely used on account of the confined area in which the men have to work. Mules were lowered through the workmen's shaft and are now used in the tunnel. Work is carried on by relief shifts through the 24 hours of the day, so that the drills are never idle.

It is proposed to utilize most of the power generated in the City of Toronto, some 90 miles distant.

THE CANADIAN NIAGARA COMPANY.

I did not have an opportunity of visiting the works of this Company, but the general scheme is similar to that last described. The power house is built immediately over the wheel pit, and the water, after passing through the turbines at the bottom, is discharged into the river again through a tunnel.

For the following details of the plant to be installed I am indebted to *The Canadian Engineer*.

"The wheel pit is now excavated, and a considerable part of it lined. It is 165 feet deep, 18 feet wide inside of the brick lining, and 570 feet long.

Of the eleven mouths for as many turbines nine will be placed in position now, and six of these are having wheel pits cut and bricked up ready to attach the machinery on delivery. The turbines, each of a capacity of 12,500 H.P., were designed by Escher Wyss & Co., of Zurich, Switzerland; and are of the twin Francis vertical type, inward discharge, two draft tubes to each unit, discharging into the open tailrace below. Three of these units are being manufactured and installed by this firm, and two units on the same design by J. P. Morris & Co., Philadelphia.

The generators, each of 10,000 H.P., are of the internal revolving field type; and will generate alternating 3-phase current, 25 cycles, at 12,000 volts. Five of these are being installed by the General Electric Company. The generator and turbine are direct connected by a vertical shaft, and will revolve at 250 R.P.M.

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The transformer station, equipped with water cooled transformers, has a present capacity of 25,000 H.P.

There will also be a stand pipe, 116 feet high and 30 feet in diameter, carrying one day's supply of water to be drawn upon in case of any accident to the (cooling) pumping system."

As regards the relative costs of the two methods adopted, the schemes of the two last-mentioned Companies, in spite of the fact that the excavations for the tunnels were through the solid limestone of the Niagara plateau, would appear to be much less expensive than that in which steel flumes were used.

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GORDON AND GLADSTONE.

By COLONEL D. CORRIE WALKER, LATE R.E.

IF the two men whose names head this had ever met, ever had familiar speech with one another, ever become something approaching to intimate, and each learnt to appreciate what was great in the other—what might such intercourse have brought forth? Or *could* they ever have got to know one another in this mortal existence, in which souls are so strangely handicapped and limited, that every man, as Oliver Wendell Holmes said, is really *three* men in one :—

The man as he imagines himself.

The man as others see him.

The man as God knows him?

These questionings are rather raised than laid by the perusal of the "Soudan" episode in the third volume of Morley's *Life of Gladstone*.

In the fateful year 1884 the lives of these two men touched one another. The thirty pages of the book that relate what came of this contact give us a very interesting study of Gordon from the Gladstone-Morley point of view. We get the impression at the outset that to the statesman the Soudan was simply an encumbrance and a bore, an unhappy region over which our protected vassal, Egypt, lorded it with cruel and oppressive hand. His openly expressed sympathy was with the oppressed and plundered people.

The force under Hicks ("a capable and dauntless man") had been overwhelmed on November 5th, 1883. The London Cabinet then decided against employing a British or Indian force in the Soudan; and so evacuation was decided on. "Those who knew the Soudan best approved the course," and among them Gordon himself. Besides which the reforms which have since made Egypt what it is would have been impossible if its Government had been burdened with the re-conquest and administration of the Soudan. Mr. Gladstone, we learn, had stood alone in objecting to the Suakim expedition, and he is held to have been justified by the event. "The operations had no effect upon the roll of the fierce Mahdi wave over the Soudan."

At this point the responsibility for action is largely shifted from the Premier to "Ministers," who had twice enquired of Baring "whether General Gordon might not be of use." "Unhappily a third application from London at last prevailed; and Sir E. Baring, supported by Nubar, by Sir Evelyn Wood, by Colonel Watson, who had served with Gordon and knew him well, all agreed that Gordon

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would be the best man if he would pledge himself to carry out the policy of withdrawing from the Soudan as quickly as possible." Lord Granville submitted the matter to his Chief who returned a truly oracular answer, an answer which might have applied well to a military Gladstone, but scarcely to a Gordon! The General is to report what should be done, not to be the judge of who should do it, nor even to "commit us on that point by advice officially given" (*sic!*). Imagine Gordon stopping short, say at Wadi Halfa, to write reports and receive answers!

On January 18th four Ministers met in the War Office at Pall Mall, Lord Wolseley bringing Gordon, who left that same evening for Calais. He is represented "according to a very authentic account" arguing with a somewhat light sense of the danger of his enterprise. "Thus in that conclave of sober statesmen a tragedy began."

The estimate of Gordon is too long to quote. It ends as follows:— "All this was material enough to make a popular ideal, and this is what Gordon in an ever-increasing degree became, to the immense inconvenience of the statesmen, otherwise so sensible and wary, who had now improvidently let the genie forth from the jar." And now comes a very important crisis. At Cairo, Baring and Nubar, after discussion with Gordon, altered the mission from one of advice and report to an executive mission. Still evacuation was the fixed policy. To this policy of "evacuation and abandonment" Gordon was to adhere; and the British Government was to leave him a free hand.

Neither party according to our author kept this compact, an important admission. Some detached extracts will give a good idea of the rapid development of Gordon's policy according to Mr. Morley. "Gordon's policies were many and mutable . . . frightful embarrassments enveloped him . . . he had undertaken his mission without any serious and measured forecast . . . once at Khartoum, at first he thought himself welcome as a deliverer, and then . . . flung the policy of his mission overboard . . . when March came he flung himself with ardour into the policy of smashing up the Mahdi . . . he (finally) declared that to leave outlying garrisons to their fate would be an indelible disgrace." This last was the crucial point: and here we get a valuable side-light. Lord Hartington said "the Government were under no moral obligation to use the military resources of this empire for the relief of those garrisons." "I do not admit," said the Minister very sensibly, "that General Gordon is on this point a better authority than anyone else." "Mr. Gladstone at first, when Gordon set all instructions at defiance, was for recalling him." And now comes the very important Zobeir episode.

Almost immediately on his arrival at Khartoum Gordon demanded that Zobeir Pasha should succeed him as Governor-General on his retirement. Baring, Nubar and Stewart, after consideration, backed

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this proposal. "Mr. Gladstone had become a strong convert to the plan of sending Zobeir." Thus this all-important step wavered in the balance until internal changes of side within the Cabinet decided against it—and against Gordon. The Queen had also agreed. The blame is laid by the biographer upon the "Parliament and people of England."

The toils now closed rapidly around the noble quarry. Almost the moment that the leading chiefs became aware that they were to be left alone, they began to fall away to the Mahdi. By May 26th Gordon and Stewart were shut up in Khartoum. Then followed nearly three months of tedious consideration and delay; for which however the Premier is not blamed by his biographer, who speaks of ignorance of the country and the river, distracting counsels, etc., while he claims credit for the vigour with which the Nile Expedition was prepared for when a decision had once been arrived at, and gives full credit to the troops for splendid perseverance in face of almost preterhuman difficulties. But, as we know too well, all was "too late for Gordon and Khartoum." Several, at least, of those statesmen who guided affairs at home, are still great figures in the political world, but :—

> "Not here but somewhere in the far Soudan
> *He* lies—earth knew no simpler, nobler man."

The Premier, we learn, when the news came was staying at Holker. "The Queen sent an angry telegram . . . not in cypher as usual, but open." Mr. Gladstone to the last seems to have imputed blame to the man whom he nevertheless spoke of as a "hero of heroes"; blame for "turning upside down and inside out every idea and intention with which he left England, and for which he had obtained our approval," and for not coming away from Khartoum when he saw that the pacific mission was a hopeless failure and his military means inadequate.

In a note by Mr. Bright of March, 1885, just after the Vote of Censure had only been averted by a majority of 15, we find the Premier saying "The sending Gordon out a great mistake—a man totally unsuited for the work he undertook." Mr. Gladstone never saw Gordon. He was appointed by Ministers in town, and Gladstone concurred; but he had never seen him. Fortunately the veteran statesman has left us a happier last word to finish with :—"I do not doubt that a true and equitable judgment will eventually prevail."

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TRANSLATIONS.

PROGRESS OF WIRELESS TELEGRAPHY.

Extracts from the KÖLNISCHE ZEITUNG *of 20th and 23rd November*, 1904.

Nearly two years have elapsed since Marconi claimed to have succeeded for the first time in transmitting a telegraphic message through the ether across the Atlantic Ocean by means of electrical spark waves.

The announcements of the Marconi Company, promising the installation, within the shortest possible time, of a cheap system of wireless trans-atlantic spark telegraphy between the two giant stations at Poldhu and Cape Breton, were received at the time with great jubilation; now they are already forgotten, which proves that the telegraph cables connecting the old and the new world, and running at the bottom of the sea free from disturbance, fully meet the present requirements. Once more has Nature given man an instructive lesson; elementary forces, such as the electricity of the atmosphere, cannot be mastered; and should Marconi's wireless trans-atlantic telegraphy ever become a reality, these forces will make their influence felt.

However, great progress has certainly been made during the last two years in the domain of wireless spark telegraphy. We possess to-day serviceable installations which permit of the safe transmission of messages up to a distance of 1,000 kilomètres—in round figures—across water and of 300 km. across land. On the other hand it has been impossible up till now to establish a practical system of wireless telephony.

The practical application of wireless spark-telegraphy is chiefly due to the German Company for Wireless Telegraphy, which has been able to unite the advantages of the Slaby-Arco and Braun-Siemens systems in a new one, called the Telefunken or Telespark, which is recognised, even abroad, as the best in the world.

The Telespark system at present employs for stations of medium carrying power (*i.e.*, for distances of from 200 to 300 km.) single senders having the form of the Hertz exciter; and for stations of greater carrying power, as well as for installations requiring to be specially guarded against disturbances caused by the working of other stations, coupled senders with Braun's oscillator circuit. In the single Hertz exciter the two poles of the spark-gap are each connected with one conductor; one is carried upwards and forms the transmitting wire; while the second takes the form of a horizontally outstretched wire-gauze and, as an insulated electrical counterpoise, equilibrates the aerial conductor. The

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electrical energy, which, at the generating of the discharge-spark, produces the oscillations and thereby the carrying power, is stored, before the generating of the discharge-spark, in the aerial conductor or counterpoise.

A similar transmitter arrangement was also formerly used by Marconi except that he used a direct earth connection in place of the counterpoise. It is impossible with such a primitive arrangement to radiate into space larger quantities of electrical energy, the limit of efficiency of such installations being reached as a rule at a distance of 50 km. The insufficient effectiveness of the sender was the result of the spark-gap arrangement. If, for example, the distance between the pole-balls of the spark-inductor (*i.e.*, the length of the spark-gap) was increased to more than 5 cm., it became impossible, when using an aerial wire 60 mètres long, to obtain oscillating spark discharges; in their place the discharge became a continuous one in the form of a luminous arc. Nothing but oscillating spark-discharges will produce electrical carrying-power. It is true that lately it has been possible, by the use of spark-inductors tuned to resonance, to increase the spark-gap to 30 cm. with an aerial conductor 60 mètres long, and thus to obtain also an increase in the discharge tension and a considerable augmentation of the electrical energy radiated into space; but it was soon seen that the increase of carrying power in no way kept pace with the lengthening of the spark-gap. The reason for this is found in the great loss resulting from spark-gaps with great sparking distance, a large part of the electric energy being converted into heat and thus lost for radiation.

To remedy this evil Prof. Braun replaced the ordinary long spark-gap by a number of small ones, the technical construction of which was carried out by the engineer Hagar Rendahl; they are now in general use under the name of the Braun-Rendahl series spark-gap. Instead therefore of a single spark-gap of great length, a discharge spark-gap is used which consists of several small partial sparks mounted in series. In order that the desired effect of the separate heat losses may be obtained, tension dividers (in the form of small condensators of very small capacity) are mounted in this series spark-gap, parallel to each small spark-gap. These new senders of the Telespark system work with such high efficiency that, even with 90 watts of primary inductor energy (=0·12 horse-power) and with an aerial wire of only 32 mètres in height, a distance of 250 km. can be spanned.

The arrangement of the coupled senders of the Telespark system corresponds in general to the connections of the old Braun-Siemens system. There are two distinct couplings, the electric and the galvanic; by the former is understood the connection of the Braun closed Leyden-jar circuit with the aerial conductor by means of inductive transference; by the latter the direct metallic connection of the aerial conductor to a point of the closed oscillator-circuit.

A considerable improvement has been brought about in the Braun-Siemens sender by the addition of the Braun energy-connection and the above-mentioned series spark-gaps. The Braun energy-connections render possible an increased carrying-power by increasing the capacity

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(*i.e.*, the electrical susceptibility) of the exciter-circuit relatively to the spark-waves, without thereby impairing the electrical or galvanic coupling as has occurred hitherto with all spark-telegraph senders. Prof. Braun no longer employs for the sender a single exciter-circuit or oscillator-circuit, but several such circuits, each of which is tuned to the same number of oscillations as the former single circuit. Each of these oscillator circuits receives from an electric high-tension generator the same amount of energy as the former single circuit; in this wise ten oscillator-circuits, for example, are able to transmit tenfold energy to the transmitting wire. It is, however, essential that the single circuits should have exactly similar oscillations, and that the electrical oscillation should arise simultaneously in each of the circuits. The coupled senders of the Telespark system, besides larger carrying-power relatively to the single sender, have the advantage that with a given aerial wire the radiated wave-length can be altered within fairly wide limits without weakening the intensity. This fact is of very high importance for military stations, which are thus enabled to make use quickly of a new and altered wave-length when disturbed by hostile installations. It is, for example, easy to change for such a purpose from a wave-length of 300 m. to one of 900 m.

For the receiver of the spark-waves the Telespark system employs a number of new connections, all of which are so chosen that one and the same maximum receiver intensity can be obtained with each. The receivers are either sharply tuned or non-sharply tuned. The method of connection for non-sharply tuned receivers is intended for stations which have to work in conjunction with others not tuned to a similar wave-length, without continually altering their regulating apparatus, as for example for the installations on transatlantic fast steamers. Sharply tuned connections, on the other hand, are of special importance for military stations, in order to exclude hostile disturbances even in the case of a slight difference in the wave-length. The sharpness of the tuning of a receiver connection is mainly determined by the degree of coupling of the oscillator circuit containing the coherer, or other wave-indicator, with the receiving aerial-conductor. Sharp tuning requires loose coupling, and non-sharp tuning fast coupling, of the receiving oscillator circuit with the aerial conductor.

The most notable practical success of which the Telespark Company can boast is the constructions and introduction of the electrolytic wave-indicator invented by the engineer Schlomilch. This receiving apparatus is the most sensitive and reliable of all wave-indicators hitherto invented; it answers even to the smallest energies of an alternating current, *i.e.*, to the weakest spark-wave. The construction of this indicator is based on the stronger activity of the polarisation cells when exposed to the rays of electric waves. An ordinary polarisation cell consists of a small closed glass vessel filled with diluted sulphuric acid, having soldered into its upper part two gold or platinum wires which dip into the liquid and serve as electrodes. If such a polarisation cell be connected with a current generator, the electromotive force of which is somewhat higher than the counter electromotive force of the cell, the electrolytic current

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passing through the cell causes a minimum formation of vapour at the electrodes. As soon, however, as the spark waves pass to the cell over the aerial conductor the formation of gases becomes very active; it then becomes possible after some practice to read the wave impulses, and thereby the Morse signs of the transmitted message, direct from the cell. If an ordinary Morse receiver be connected with the cell, the signs will be registered on a strip of paper in the Morse alphabet; if a telephone be connected with it, the Morse signs can be heard as long or short clicks of the telephone diaphragm. The small dimensions of this instrument cause well-justified astonishment; the glass vessel is of the size of a hazel-nut, the electrodes are 0·001 mm. thick and 0·01 mm. long.

The new Telespark apparatus, and particularly the Schlomilch wave-indicator, have successfully undergone their crucial test in German South West Africa and in the Far East. According to the official reports of General von Trotha, messages have been sent through the air to distances of over 150 km. by means of the new portable Telespark stations. Although connection was broken during the prevalence of heavy tropical thunderstorms, this was of no importance; for, as soon as the atmospherical electricity was to some extent compensated, spark telegraphy became once more possible. During heavy thunderstorms it is also impossible to telegraph with the ordinary wire system. At the beginning of December, 1904, three further portable Telespark stations will be sent out for the colonial forces in South West Africa; these have a carrying-power of as much as 300 km. The expenditure will be covered in part by the saving in men and animals for the intelligence department, and the stations will ensure greater promptness and safety in the execution of military orders. Wireless installations cannot be destroyed by savages unless the whole station falls into their hands, in which case they will destroy the mysterious machines without being able to make use of them. Wire telegraphs and heliographs the savage is already acquainted with; opportunities for cutting the wires are quickly found, and from the flashes of the heliograph lamps he is soon able to draw conclusions. The safest means of communication for our colonies in unsettled times are therefore the wireless installations; and where no political disturbances are to be feared, they will form a welcome addition to the wire telegraphs. For the service of a wireless station, thoroughly trained telegraphists are, of course, essential. For the attainment of such skill many years of training are required, as well as constant practice. No wireless operator should be sent out who cannot correctly read by ear at least 20 words a minute in the Morse alphabet. If the Telegraph Troops have not a sufficient number of such trained operators the Imperial Telegraph Department will be able to supply them.

Equally favourable results with the Telespark system have been obtained by the Russians during the present war. They have succeeded in spanning Lake Baikal by spark-telegraphy; and nearly all large men-of-war have been fitted with Telespark apparatus, all the vessels of the Baltic Fleet being provided with them. In the naval battles before Port Arthur the wireless apparatus worked until smashed by shot; this of course teaches us that the apparatus must be better protected than

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hitherto from shells. The Russian installation for wireless telegraphy at Chifu, which was for a long time the medium of communication between Port Arthur and the outer world, and which later on was closed in consequence of the Japanese protests and the diplomatic representations of China, was likewise provided with Telespark apparatus. The Russian army has also a large number of portable Telespark stations in use. The Japanese have of course made similar use of wireless telegraphy in their operations; they employ the old Braun-Siemens system, which Prof. Kimura has very cleverly imitated.

As the latest epoch-making invention in the domain of wireless telegraphy there still remains to be mentioned the high-frequency sender arrangement of Prof. H. Th. Simon, of Gottingen, which is based on the employment of mercury vapour-lamps as spark-gaps. This invention may be destined to mark a new era in the development of wireless telegraphy. The present telegraphic spark-senders do not radiate the waves continuously but in separate wave-currents, which are divided by the pauses between the spark discharges. Such wave currents, interrupted by relatively long pauses, are unable to produce sharp radiation capable of resonance; they have therefore always been an impediment in the way of absolutely safe tuning of the stations to equal wave-lengths. Prof. Simon, in conjunction with Dr. Reich, has succeeded in reducing to a minimum the pauses between the separate discharges, and thus in sending out continuous and undamped electrical oscillations.

The great point of his invention is the generating of alternating currents of an extremely high frequency (*i.e.*, number of oscillations per second). In his trials he made use of an Aron Hewett mercury vapour-lamp, *i.e.*, a species of electric arc lamp in which the electrodes consist not of charcoal rods but of mercury. Such lamps are now being introduced for lighting purposes under the name of Cooper Hewett lamps. The mercury vapour-lamp represents a spark-gap in an airless space, *i.e.*, a vacuum spark-gap. The waves generated are, as regards their character, identical with those of the air spark-gaps hitherto used. With such vacuum spark-gaps, the discharge-tension can be considerably increased in the same way as with Braun's series spark-gap, and one is thus enabled to bring considerably more energy into the oscillations. Simon, with a continuous current generator of 5,000 volts, obtained a discharge-tension of 50,000 volts for the mercury spark-gap. He now asks engineers to undertake the construction of high-tension dynamos of the requisite resistance for continuous currents of a tension of from 10,000 to 20,000 volts. By means of such machines the discharge-tension of the mercury spark-gaps may be increased to such a degree that the pauses between the separate discharges disappear and continuous electrical waves are radiated.

Foreign countries have not made any notable inventions or progress during the last two years in the realm of wireless telegraphy. At the side of the Marconi system, there have been introduced into practice in a minor degree the Fessenden and the De Forest systems. The characteristic feature of the former is the barretter or liquid column wave-indicator; that of the latter is likewise an electrolytic wave-

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indicator, called the responder. This apparatus consists of two metal electrodes, enclosed in a glass or ebonite tube, between which is fixed a paste made of filings, glycerine or vaseline, and oxide of lead with traces of water or alcohol. Under the influence of a small galvanic element, the filings, which are distributed throughout the whole paste, form a conducting bridge of comparatively small resistance from one electrode to the other. As soon as this bridge is irradiated by electric waves, i collapses into itself in consequence of a considerable increase in the resistance resulting from the depositing of great masses of minute hydrogen bubbles at one of the electrodes; after cessation of the electrical irradiation, it instantaneously returns to its original state. This advantage of rapidity is shared in common by the responder and the Schlomilch polarisation cell-indicator; but while the latter can be used for years without requiring any attention, the paste of the responder must be renewed every three days.

The *Haimun* despatch-boat, which *The Times* sent out to the scene of operations in the Far East, was fitted with a De Forest wireless installation. The vessel was able not only to maintain communication with the land station of the same system, erected at a distance of about 200 kilomètres, but also to catch most of the wireless telegrams of the Russians and Japanese, which of course were mostly in cipher. The correspondent of *The Times*, who was in charge of this wireless service, also reports however that the successes were obtained solely by the extraordinary skill of the operators in the reading of messages by ear.

As the distinguished English telegraph engineer, Nevil Maskelyne, has now joined Dr. De Forest, we shall not be wrong in stating that the De Forest system will enter as a new and no mean rival into the competition now going on between the Marconi and the Telespark systems. A healthy and fairly-conducted competition cannot but promote development.

In England private wireless telegraph installations, which had been independent, are now placed under the control of the Government, which is thus in a position to fix the conditions of concessions as it may think proper. The United States of America have put all private installations under the Department for Trade and Industry. There remains therefore only Italy which fully recognises the Marconi monopoly, and is not prepared to admit the free competition of all wireless telegraph systems provided they offer proper guarantees for a well-regulated telegraph service.

Till lately the Marconi stations controlled the Atlantic route. Now ships fitted with the Telespark system are able to communicate with the German North Sea stations at Cuxhaven, Heligoland, Sylt and Borkum. On the Dutch coast there has lately been thrown open to public traffic by the Dutch postal authorities the station at Sheveningen, fitted with the Telespark system; besides this there is open for public use at Amsterdam a station belonging to the Telespark Company under the control of the Dutch Government. France has established a large station on the Island of Quessant, open to all systems, the service being in the hands of the French Post Office. In America the station on the

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Nantucket Light Ship is now also open to all systems, and is controlled by the U.S. Lightship Board; stations are also being erected at Haversink, Cape Cod and Montauk, which will be fitted with the Telespark system and thrown open to public use. For the South American service the Telespark system already possesses a number of coast stations, others are in course of erection, and various steamers of the Hamburg American Line are being fitted. On the Brazilian coast two Telespark stations are at work, one at Santa Cruz and the other on the Ilha Grande (Rio de Janeiro); they have on various occasions been in communication with Italian men-of-war, which of course are fitted with Marconi apparatus.

In the domain of wireless telephony no inventions or improvements of great importance are to be recorded apart from the above-mentioned invention by Simon of a continuous wave-transmitter; this furnishes the theoretical solution of the problem of wireless telephony by means of spark-waves. Even Simon's well-known electric-light telephony, in which the electric arc-light is used for the transmission of speech through the air, has not yet been practically developed. Still, a certain amount of progress can be reported; Prof. Simon, in his electric-light trials, was able to establish wireless telephonic communication up to a distance of 3 kilomètres; and the Berlin physicist E. Ruhmer, who has taken a leading part in the practical working-out of Simon's electric-light telephone system, finally succeeded, by means of specially sensitive selenium cells (constructed by himself) for the receiver station, in transmitting speech up to a distance of 15 kilomètres.

The idea naturally followed to make use of the electric spark-wave for wireless telephony in a similar way as for wireless telegraphy. Nothing practical has been done in this direction, but the trials made by Profs. Simon and Reich lead us to hope that the continuous electro-magnetic waves, generated by high-frequency alternating currents by means of the vacuum spark-gaps, can be made use of for wireless telephony—spark-telephony—for long distances. It will only be necessary to adapt the strength of the spark-waves to that of the speech-waves; this can be done either by altering the wave-length while making permanent the strength of the radiated waves, or by altering the strength while retaining the wave-lengths. Prof. Fessenden of America has described methods of connections for both cases, but cannot show any practical results. Dr. Mossler of Brunswick, the Danish engineer Waldemar Paulsen and others claim to have attained results; but it is still impossible to form a judgment on the practical utility of their trial installations.

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REVIEWS.

GAME, SHORE AND WATER BIRDS OF INDIA.

(With Additional References to their Allied Species in other Parts of the World).

By Colonel A. Le Messurier, c.i.e., f.z.s., f.g.s., late R.E. 4th Edition.—(London: Thacker & Co., 1904).

This important work, embodying the original notes and sketches of an ardent naturalist and sportsman in India, first appeared (minus the sketches) in 1874, for private circulation only. A second edition was issued to the public in 1878, and a third, to which the sketches and much additional matter were added, in 1887.

The present (fourth) edition made its appearance last year, and will doubtless prove as popular and as much in demand as its predecessors. Its general scheme is still that of the 1874 "Notes"; but the whole character of the details has been altered by the addition of a careful series of references to all known genera and species of Game, Shore, and Water Birds occurring in other parts of the world. This has, of course, necessitated an immense amount of work on the part of the Author, but he gives us an excellent reason for the innovation in his Preface, where he says: "These additions seem necessary, as, owing to the facilities of travel, Anglo-Indians are now engaged in most countries either on business or pleasure." Any sporting Anglo-Indian finding himself among strange birds in a, to him, new country, will certainly welcome these additional references contained in his familiar Indian *vade-mecum*, for they will prove of great and constant use to him. And though a keen ornithologist would doubtless prefer to take with him a reliable book on the avi-fauna of the particular country concerned, Colonel Le Messurier's work was written chiefly for sportsmen, and is very compact and portable, and sportsmen do not carry about with them in their kit more books than they can help. So we may safely predict a large circulation for this fourth edition among the ever-increasing numbers of sporting Anglo-Indians.

With the scope and arrangement of this work there is little fault to find from a sportsman's point of view; it is portable, useful, and up to date. But I may perhaps be allowed to suggest that the addition of a map, or maps, of the various regions of India, with brief notes on their peculiar avi-fauna, would be of very great assistance to the sportsman and collector; while it seems a pity that the numerous sketches could not have been reproduced a little more elaborately. Another useful improvement might

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be effected by printing the characteristic features of a species, where such exist sufficiently marked to distinguish it at once from other allied and similar species, in italics or some other conspicuous type.

Up-to-date ornithologists may possibly find fault with the classification adopted, as being somewhat old-fashioned; and there are, as might be expected in a work of such extended scope, some errors and omissions more or less important. But on the whole there is an immense amount of valuable information, and that easily accessible, within the (roughly speaking) 300 pages of Colonel Le Messurier's book; and it is one that can heartily be recommended to all those who are fond of birds and of shooting, and who are likely to find themselves quartered in India at any future time.

SAVILE G. REID.

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GENERAL SIR HENRY DRURY HARNESS, K.C.B., ROYAL ENGINEERS, 1804–83.

(R.E. Institute, Chatham. 3s. 6d.).

This book is a memoir collected and arranged by the late General Collinson, R.E., and edited by General Webber, C.B., R.E., London, 1903. It contains a series of papers written by various officers who came into intimate contact with him during his eventful life.

The memoir opens with an introduction giving a brief summary of General Harness's life. He was born in 1804, and died at Oxford, February 10th, 1883. He passed through the Royal Military Academy at Woolwich, leaving in 1824, and was delayed in obtaining a commission, as there were no vacancies at that time. He went to Mexico as superintendent of a silver mine and returned to England, obtaining his commission in 1827 as Second Lieutenant of the Royal Engineers. He was successively promoted to the various grades, becoming major-general in 1868 and colonel commandant in 1877, and in the same year he retired with the honorary rank of general.

The various distinguished services of this officer are set forth in the succeeding chapters of the book in the form of biography and correspondence, briefly described as follows:—

1. Mexico, 1825; Royal Military Academy, 1834 to 1844 and 1852, by General Collinson.

2. Report of the Irish Railway Commission, arbitrator between the Post Office and Railway Company, and work as Secretary to the Railway Commission of 1846, by General Hutchinson.

3. The Reform of the Royal Mint, 1850 to 1854, by General J. H. White.

4. Board of Public Works, Ireland, 1854 and 1855, by General Sir R. H. Sankey.

5. The War Office, 1855 and 1856, and Malta, 1856 and 1857, by General Collinson.

6. The Suppression of the Indian Mutiny, 1857 to 1860, by General Webber.

7. Education and Organization of the Engineer Service, 1860 to 1862, by General Collinson.

8. Royal Engineers' School, Chatham, 1860 to 1865, by General Collinson.

9. Retirement, 1865 to 1883, by General Collinson.

The book is very readable and instructive and portrays the versatile talents of General Harness. He possessed executive ability and a business discrimination to a remarkable degree. This, added to his capabilities

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and training as a soldier and engineer, made him at once an important figure in the economic questions of the time far above his actual duties and position.

As General Collinson says in his preface, he possessed a powerful mind and a large heart, and underlying these was a deep religious feeling. The circumstances of his career and his inclination turned him to mathematical and physical problems, but he could readily apply his mind to any of the great questions of the day. His papers were valuable not only for the light they threw on the particular questions dealt with, but for the fine general principles they contained. His face was a tower of strength, and you could feel with him what true loyalty meant. These qualities made him what he himself wished to be—a true soldier. He had also another quality, and that was his deep-seated faith in the government of the world by a divine and beneficent Creator, which influenced his dealings with all men.

During his active life he devoted his whole energies to the uplifting of the army, and especially of the engineer service. While at Woolwich he assisted Capt. Denison in starting "The Professional Papers of the Royal Engineers." In 1840 he was instructor at the Royal Engineer School at Chatham; in 1855 he was appointed Deputy Inspector-General of Fortifications, and in 1860 Director of the Royal Engineer School at Chatham.

After his retirement he lived for nearly seventeen years at Warting, near Basingstoke, but he was several times called to active service on important missions, viz.:—In 1866 on the cattle plague; 1868, Royal Commission on Water Supply of London; 1869, Council of Military Education; and 1876, President of a joint Board of Artillery and Engineer Officers upon Siege Operations. He also devoted considerable time to the theological discussions of the Church at that time. His intimate friend to the last was Reverend G. R. Gleig, Chaplain-General of the army. His career reflected new glory on the Corps of Royal Engineers, of which he was an honoured member.—*Journal of the Military Service Institution, U.S.A.*

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NOTICES OF MAGAZINES.

NATURE.

PATAGONIA.—Colonel Sir Thomas Holdich, R.E., was chosen as the head of a commission to arbitrate between Chili and Argentina with regard to the boundary line of their Patagonian possessions. He had already served his country as boundary commissioner in the wild inaccessible lands that lie to the north-west of India, and he has now by his tact and skill traced a frontier more than 800 miles in length in such a manner as to accomplish the almost unprecedented feat of satisfying both parties. In his new book *The Countries of the King's Award* he gives us his impressions of the progressive republics of Chili and the Argentine and a most interesting account of the little-known country of Patagonia, with its mountains, valleys, forests and glaciers; a land of striking illustrations of long-established principles and of problems that will require many years of search to solve, of the story of its making of which Darwin wrote the first chapter.

CHANGES UPON THE MOON'S SURFACE.—Until within the last few years there has been a very general opinion that the moon was a cold, dead world, a burned-out cinder, upon which nothing ever happened. Prof. Pickering as the result of his lunar observations in Peru, Jamaica and California has come to the conclusion that physical changes do occur upon the moon, due (*a*) to volcanic action, (*b*) to frost, and (*c*) to vegetation. In the first class (*a*) the crater Leimè was, 60 years ago, 5 miles in diameter, whereas at present it is only three-quarters of a mile. The floor of Plato, 61 miles in diameter, was surveyed in 1870 by a committee of the British Association, next by Mr. Williams and others in 1881; then by Mr. Pickering at Arequipa in 1892, and again in this past summer in California. In each survey about 40 craterlets have been mapped, and each time some new ones have been discovered, while at the same time a few of those previously observed had ceased to be visible. The original trigonometrical survey of 1870 was based upon four craterlets near the centre of the floor, and selected as primary stations. The easternmost of these was last seen as a crater in 1888, a trace of it only was glimpsed in 1892, but a search for it in 1892 with a 16-inch telescope under excellent climatic conditions failed to reveal any trace of it. Turning now to the second class of physical changes, those due to the formation and disappearance of hoar frost, one of the clearest evidences is found in connection with the pair of small craters known as Messier and Messier A. When the sun rises upon them they are both of the same brilliancy as the

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mare upon which they are situated, but three days later they both suddenly turn white, and remain so until the end of the lunation. When first seen the white areas are large, but gradually diminish in size under the sun's rays. In the crater Eratosthenes (37 miles in diameter) there is a brilliant white area on the summit of the central mountain range, 5 miles long and 2 miles broad. It soon, however, begins to dwindle, and two and a-half days later all is gone save two little spots each about a mile in diameter, reaching a minimum of half a mile in diameter five days after sunrise. They then begin to increase, the northern one attaining a length of 5 miles shortly before sunset.

The third class of physical changes may be due to vegetation. There can be no liquid water on the moon's surface, because as we reduce the atmospheric pressure the boiling point of water is gradually lowered, until when we reach a pressure of only 4·6 millimètres, the boiling and freezing points coincide. Below this pressure ice changes at once into the gaseous form without passing through the liquid state. There is nothing however to prevent water from occurring beneath the surface of the ground, retained by the capillary action of the soil. This action is so strong that it is capable of extracting water from a membrane against a calculated osmotic pressure of 36 atmospheres. Since on the earth plants can live on moisture which they have extracted from such a soil, there seems to be no difficulty in understanding how they could live on the moon in a soil which could thus retain considerable moisture in spite of the low atmospheric pressure. The presence of vegetation explains how when the sun first rises on the crater of Eratosthenes the floor is found to be of a light grey tint, which gradually darkens as the sun shines upon it and later fades out again. The reason why the earth has oceans is that it is large enough and massive enough to retain the water expelled from the rocky materials of its crust with which it was previously united by the forces of crystallisation. The moon, on the other hand, is too small to do so, and the water therefore appears scattered over its surface in the form of hoar frost before being dissipated into outer space. Mr. Romanes (and other writers) deny this volcanic action and think that there never had been sufficient heat developed in the interior of the moon by gravitational compression to account for volcanic action on its surface, and that the lunar markings could be accounted for by the impact of meteoric masses. He assumes that the moon has grown to its present form and size by the gradual agglomeration of what was a ring of satellites, broadly similar to what we know to exist in the case of Saturn. Also in the absence of an atmosphere meteoric masses would impinge upon the surface with high enough velocities to render the immediate vicinity liquid. A mass of lead into which small bullets had been fired reproduced the leading characteristics of the lunar "craters," even to the small hill in the middle of the main depression.

THE LEBAUDY II. AIRSHIP made its thirtieth experiment in aerial direction at Moisson on the 22nd December, the last of the autumn campaign. The airship has been taken out in rain and in wind blowing at 5 or 6 kilomètres; it has risen to the height of 500 mètres, returning each time to its shed, after having gone away to distances so great as

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10 miles. The volume has been brought up to 2,063 cubic mètres, its length to 64 mètres, and its regular crew consists of three persons. Several times it has taken as many as six passengers. The speed attained by its own propulsion has been 40 kilomètres per hour. In its last trial the Lebaudy II. remained inflated for 64 days.

W. E. WARRAND.

REVUE D'HISTOIRE.

December, 1904.

THE CAMPAIGNS OF MARSHAL SAXE.—Carried down to the eve of the battle of Fontenoy. The problem that Saxe had to deal with, how to cover the siege of Tournay against a relieving army of 50,000 men, is fully examined, and it is shewn how his difficulties were increased by the noisy "bear-garden" of high nobility which surrounded him.

THE WAR OF 1870–1871.—*18th August in Lorraine.*—This completes the account of the battle of St.-Privat (Gravelotte). The principal subject of this section is the advance of the Second German Corps to storm the Point du Jour position, made by order of the King against the wish of Moltke. The details are drawn chiefly from Hoenig, Kunz and Verdy du Vernois, who have fully described (in Hoenig's case perhaps exaggerated) the confusion and panic which followed upon this mistaken attempt, carried out after nightfall. French records give hardly any corroboration to the statements of the German writers about French counter-attacks, and they must have been at any rate on a very small scale. Broadly, Frossard's corps confined itself everywhere to a passive defence. It was the vivacity of the French fire which made such an impression on the enemy.

E. M. LLOYD.

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CORRESPONDENCE.

RACE AND CASTE IN INDIA.

To the Editor of THE ROYAL ENGINEERS JOURNAL.

DEAR SIR,—Colonel J. E. Broadbent, in his interesting compilation, which appeared in the *R.E. Journal* of November, mars the merit of his labours by employing two contentious words in describing the method of baptism and the status of the Portuguese converts.

These two words are "forcibly" and "nominally," and they are as unnecessary as they are misleading.

Putting historical records apart, had Colonel Broadbent lived, as I have done, amongst the descendants of these Portuguese-baptised Christians, and observed their undeviating piety, especially in places where there are no "influential persons" and where piety is not a commercial asset, he would have admitted that such real Christianity could not possibly have owed its birth to force or been continued by force, and that the word "nominal" is the very antithesis of the word which truly describes their Christianity.

Yours truly,

G. P. CAMPBELL,

6. 12. 1904. *Capt., R.E.*

The above letter refers to the last paragraph under the subhead "Race" of the article referred to. Colonel Broadbent wrote:—

> *Eurasians* are of mixed European and Indian parentage; and claim to belong to the English race, as they are Christians in religion and speak English. Probably, however, the majority have no English blood, but are descended from Portuguese, Dutch and French. Some perhaps have no European blood at all, but are descendants of Hindus who were forcibly baptized by the Portuguese and so lost caste and became nominally Christians.

The letter is published as a matter of fairness, and also because it appears to impugn the accuracy of a contributor to these pages. But the *R.E. Journal* is not intended for discussion on matters connected with religion, and no further correspondence on the question under reference will be printed.

Obviously there was no intention on Colonel Broadbent's part to reflect on the Christian character of the Portuguese Roman Catholics, or to introduce controversial matter. He merely gave a possible explanation of the origin of a section of the population who call themselves Eurasians, but have no European blood in them. The converts of missionaries like St. Xavier and their descendants never claimed to be Eurasians; they were organized into congregations of *Indian* Christians belonging to the Roman Catholic Church.—EDR.

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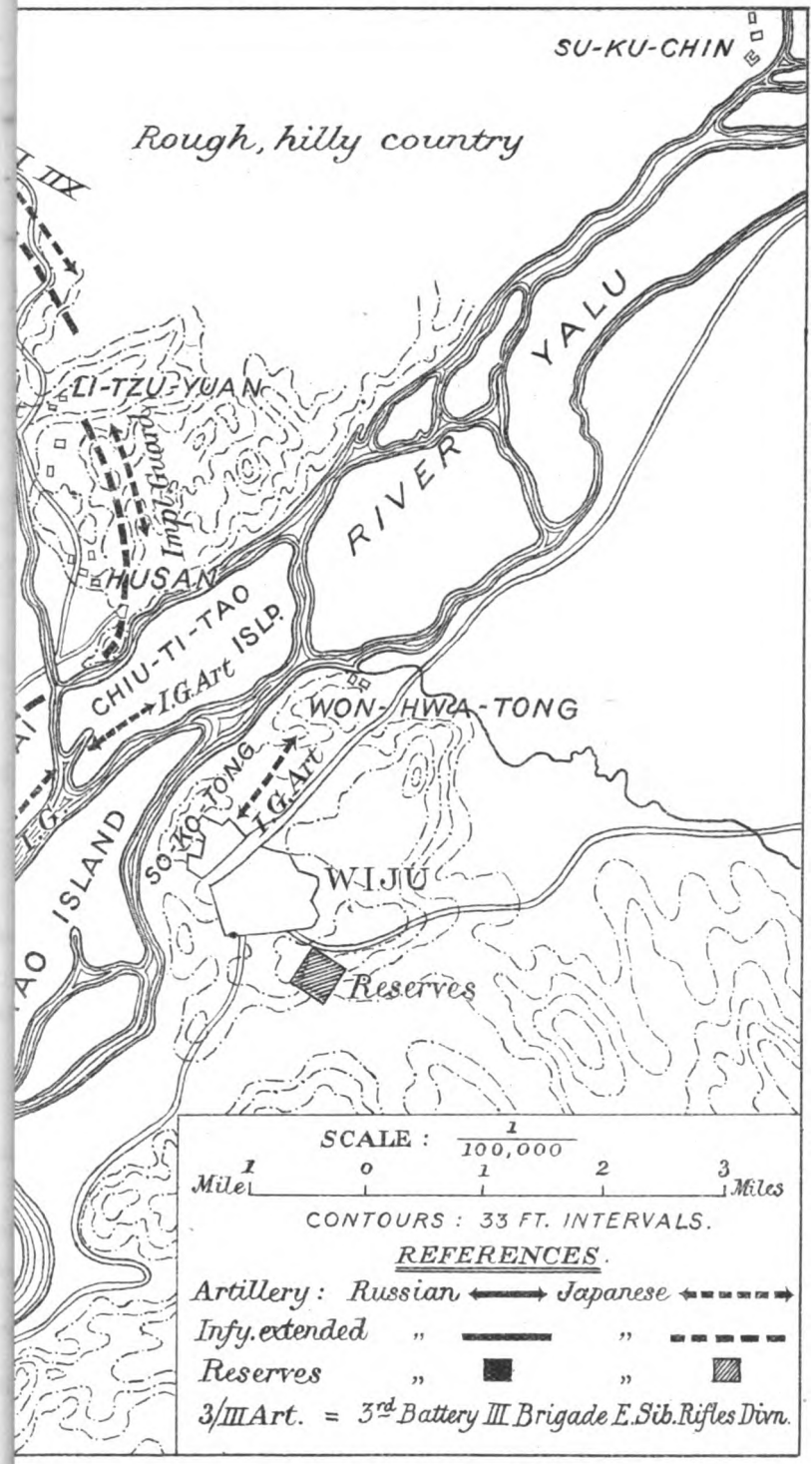

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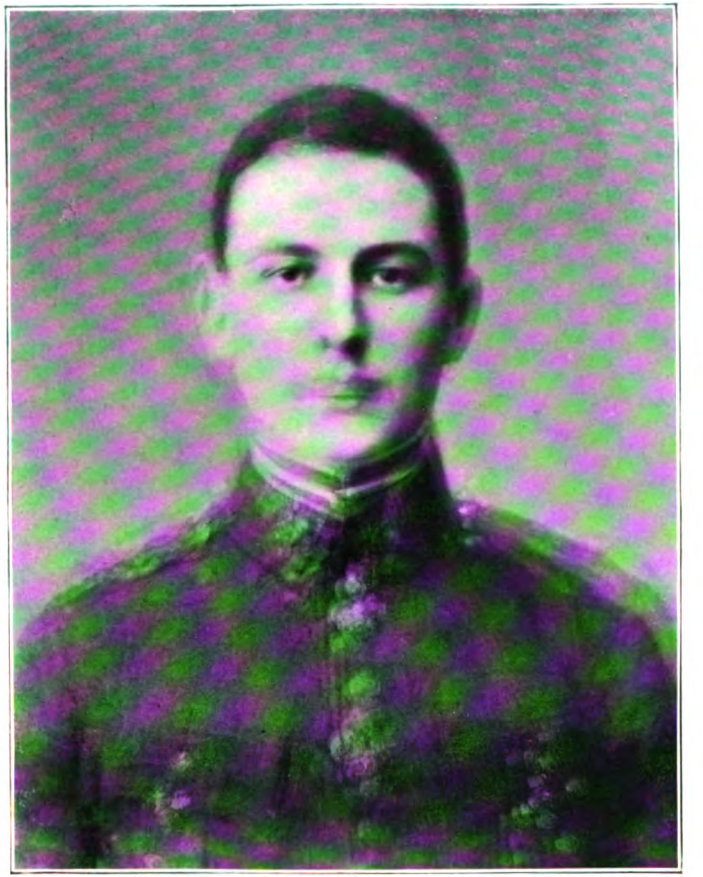

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COMPOSITE PHOTOGRAPHY: TYPES OF YOUNG OFFICERS.

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TYPES OF YOUNG OFFICERS; AN ESSAY IN COMPOSITE PHOTOGRAPHY.

A COMPOSITE photograph of a number of individuals may be obtained either by photographing each face on the same plate, or by taking separate photographs of each person and then re-photographing the positives on one plate. In each case the final negative is composed of a number of superposed images, in which the eyes are made to coincide. Results from the second method are generally more satisfactory than those from the first. The correct exposure for each individual is of course arrived at by dividing the number of seconds required for an ordinary photograph by the number of individuals who are to form the composite image.

The two photographs reproduced in the Frontispiece of this number each show a type of face which represents a mean of the individual features of sixteen recently-commissioned young officers of the Royal Engineers. It is noticeable that the composite photograph is usually better looking than the faces from which it is composed. It is perhaps permissible to say that this is the case in the two examples here shown, of which one is a photograph of the batch of officers commissioned between the 23rd December, 1903, and the 23rd March, 1904, and the other of the batch commissioned between the 23rd June, 1904, and the 1st October, 1904.

It is, of course, well known that every quality or measurement of a group of men is subject to the laws of the theory of errors, or, in other words, that any measurement of one individual will give a residual from the mean or type; and that the probability of any given divergence can be ascertained for any particular unit in a group, if the group is a large one.

Now the effect of a composite photograph is to smooth out and eliminate the divergences from the type. Therefore, if we find that the type photograph is better looking than the great majority of the individual photographs, it follows that good looks consist in conformity to type, a reflection which is equally consoling to the average and to the exceptional man.

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THE RECENT MISSION TO TIBET.

By Major A. T. Moore, R.E.

For several reasons the Tibet Mission must always occupy an honoured place in the record of military exploits. In the first place the operations conducted during the advance along the 370 miles between Siliguri and Lhasa met with natural and climatic difficulties that have never previously been surpassed; except for small tracts in the Chumbi and Gyangtse-Shigatse valleys, in the Sang Po valley near Chaksam and about Lhasa itself, the country was bleak and barren, and for two stretches of nearly 100 miles each was incapable of providing food or fuel; the Sang Po was a formidable river, rapid and dangerous; four mountain ranges were crossed by passes 14,300 to 16,600 feet in height, and actual fighting took place at altitudes of 17,000 to 18,000 feet; gales and snowstorms were frequent during the winter and 50° of frost not unusual. Secondly the physical features of their country had enabled the Tibetans to successfully adopt a policy of absolute exclusiveness from the outside world; few foreigners of any nationality, only ten or twelve Europeans (mostly missionaries) and only one Englishman (Thomas Manning in 1811) had succeeded in penetrating to the legendary capital, Lhasa; and yet a well-organized British-Indian force, in the course of a few weeks, traversed the whole route and thus revealed to civilization one of the few remaining geographical mysteries of the East. The inferior armament and tactics of the Tibetans were largely counterbalanced by their great superiority in numbers, by the natural strength of the positions chosen for defence and by the solidity of the fortifications. For Royal Engineers the Mission has a further and more direct interest in that the command of the Military Escort was entrusted to an Engineer officer, Major and Bt. Col. James R. L. Macdonald, C.B.

Tibet is governed on a sort of feudal system, the monks or Lamas being the overlords and the peasantry the serfs, a bond of union being established by the custom of each family contributing at least one member to the priesthood. The actual rulers are probably the Abbots of the three great monasteries or univerisities, who have a preponderating influence in the National Assembly, which consists of representatives of all the monasteries as well as lay officials. The nominal ruler is (or was) the Dalai or Grand Lama, with a State Council, subject to the more or less shadowy authority of the Chinese Amban or Resident; to prevent the Dalai Lama attaining too much power

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it has been customary to appoint a boy, who was deposed surreptitiously before arriving at mature age and replaced by a new incarnation of tender years. It is curious that the last Lama was the thirteenth and that he was the first permitted under the above system to reach full manhood. The exclusiveness of the Tibetans appears to have been due to Chinese influence, and to have dated from 1792; in this year they invoked the assistance of China to repel an invasion by the Nepalese, and from that time they have acknowledged, more or less clearly as it suited them, the suzerainty of the northern Power. In 1886 the Tibetans invaded Sikkim, and it was not until two years later that they were driven out by our Sikkim Expedition, which resulted in the recognition of British control over Sikkim and the definement of the Sikkim-Tibet frontier. As a further consequence, regulations for trade with India were drawn up in 1893 with the intermediation of China; the treaty included the establishment of a mart at Yatung, but the Tibetans built a wall across the narrow valley there and levied high duties on Indian goods, and they subsequently destroyed the boundary pillars and erected guard houses in Sikkim territory. The Chinese Government were requested to use their endeavours to coerce the Tibetans into respecting their obligations, but their inability to do so, even if they possessed the desire, soon became obvious. After years of desultory negotiations the Viceroy of India wrote to the Dalai Lama threatening practical measures for the enforcement of treaty rights, and the letter was returned unopened; about the same time it was definitely ascertained that Russian influence in Tibet had been increasingly exerted through certain Buriat Lamas educated in Russian, and that two (ostensibly religious) Missions had been received by the Czar.

At last arrangements were made for a conference at Khamba Jong, and Major (temporary Colonel) F. E. Younghusband, C.I.E., of the Indian Army, proceeded there in June, 1903, with a small escort; but the Chinese and Tibetan Commissioners appointed to meet him were of purposely inferior rank, the Mission was ostracised, and all intercourse refused. Later on the Tibetans began arming, and boasted of their ability to obtain help from another European Power in case of defeat. In November the Mission was recalled, and it was announced that an expedition would proceed into Tibetan territory to enforce compliance with the British terms.

Colonel Younghusband was retained as British Commissioner in charge of the new Mission; and Colonel Macdonald was entrusted with the command of the Military Escort, which consisted of a Section No. 7 (British) Mountain Battery, two 7-pr. guns (attached to 8th Gurkhas), Machine Gun Detachment of Norfolk Regiment, 3rd (Bengal) and 12th (Madras) Companies, Sappers and Miners, 150 Mounted Infantry, 8th Gurkhas, 23rd and 32nd (Sikh) Pioneers, and portions of No. 21 (British) and No. 71 (Native) Field Hospitals.

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The base of the expedition was Siliguri on the Darjeeling railway, whence a fair road existed up the Teesta Valley to Rungpo; from there a track led over the Jelap La into Chumbi, which, it may be noted, is geographically in India though politically in Tibet.

OCCUPATION OF CHUMBI VALLEY.

The first phase of the subsequent operations included the occupation of the Chumbi Valley and the period of preparation for the advance on Gyangtse, or from 15th October, 1903, to 24th March, 1904. In December, 1903, the enemy had collected a considerable body of troops to watch the Mission at Khamba Jong, and every effort was made to encourage them in the idea that our main advance was to be made from there. Thus, when the Mission withdrew into Sikkim simultaneously with the main advance into the Chumbi Valley, a number of the enemy's levies, seeing the former movement and not having time to hear of the latter, disbanded, and could not be again collected in time to resist our advance up the Chumbi Valley. The Mission crossed the Jelap La (14,390) on the 13th December and occupied Chumbi two days later; on 20th December a flying column pushed on to Phari Jong, where the fort was surrendered without fighting, thus completing our hold on the valley. On the 7th January the force crossed the Tang La (15,700) to the wind-swept plateau of Tuna (15,300 feet), where the Mission remained through the winter with an escort of 4 companies 23rd Pioneers, a machine gun section of the Norfolk Regiment, and a detachment of Madras Sappers to protect it against the 2,000 to 3,000 Tibetans who had assembled at Guru. General Macdonald with the rest of the force returned to Chumbi.

Between the Chumbi Valley and Gyangtse stretched a barren tract of about 100 miles, where not even fuel or fodder could be depended on, and before an advance in force could be made some 550 tons of supplies had to be collected at Phari. The forwarding of this mass of stores in mid-winter, over the lofty passes which separate Sikkim from Chumbi, was one of immense difficulty. The Nepalese yaks had succumbed to various diseases, and 700 ekkas were brought up to take their place on the barren uplands of Tibet; these ekkas had to be carried in pieces over the mountains before they could be utilized at Phari. The roads also were execrable, and their improvement when the soil was frost-bound a work of extreme labour. This period of preparation was one of great strain, but the necessary arrangements were completed by the 24th March, 1904.

In the meantime the Tibetans had been collecting at Guru and elsewhere; but Colonel Younghusband at Tuna had succeeded in protecting our right flank by securing the neutrality of Bhutan, whose ruler (the Tongsa Penlop) accompanied the Mission to Lhasa.

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ADVANCE TO GYANGTSE.

The second phase included the advance to Gyangtse and the period of preparation for the advance on Lhasa if necessary; this period extended from 25th March to 12th June.

On the 29th March the Gyangtse column was concentrated at Tuna. The Tibetans had now about 7,000 men in the field distributed as follows:—3,000 at Guru guarding the Gyangtse road; 2,000 at Harm, east of the Bam Tso Lake, guarding the Lhasa road, and 2,000 in reserve between Kala Tso and Gyangtse. The first-mentioned body commenced active hostilities on the 31st March, when they occupied a wall across the road near their camp at Hot Springs and some sangars on the hills; being out-manœuvred from the latter they crowded at the wall, up to which the Sikhs and Gurkhas marched without firing a shot; whilst the Tibetans were being disarmed, firing broke out on their side and a hot action ensued at close quarters, which resulted in the enemy retiring, pursued by the mounted infantry.

This defeat led to the hasty retirement of the Harm force on Kala Tso. A company was left at Tuna and the advance to Gyangtse was resumed on the 4th April, the enemy falling back before us after some skirmishing at Samando and Kang Ma.

On the 10th April, having received some reinforcements from Gyangtse, they stood at the Zamdang gorge and were again decisively beaten. The next day our escort pushed on to Gyangtse, where the fort was surrendered without resistance.

The Mission were then located in the village of Chungloo, which was fortified and provisioned; and Lieut.-Col. H. R. Brander, 32nd Pioneers, was placed in command of the escort of 500 Infantry (8th Gurkhas and 32nd Pioneers) and Sappers, 50 mounted infantry, two 7-pounders and two maxims, with sufficient transport for a Movable Column of 400 men and two guns. The remainder of the force, consisting of 300 rifles, 100 mounted infantry, and two guns, with all remaining transport, begun its return march to Chumbi on the 19th April, dropping one company at Kang Ma and another at Kala Tso, where a company had been already left on the way up. Chumbi was reached on 27th April. The weather had been very inclement, with frequent snowstorms.

Meanwhile the Lhasa officials had begged the Chinese Amban to visit the British camp at Gyangtse and effect a settlement so as to prevent a further advance; and he had promised to arrive within three weeks with competent Tibetan representatives. But the enemy having again assembled, Lieut.-Col. Brander took out his Movable Column on the 2nd May and on the 6th, by flank attacks over almost inaccessible heights, he completely defeated a gathering of 3,000 at the Kharo La. Another force of 1,600 men, who had assembled at Dongtse, took the opportunity to attack the Mission Post on the early morning of the

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5th, but were beaten off with heavy loss; they, however, occupied and strengthened Gyangtse Jong, which had been abandoned by us, mostly for sanitary reasons.

For the next two months the Mission was practically besieged, and its camp was almost daily bombarded from the Jong. Reinforcements of 200 men, including half a company of Bengal Sappers and two 10-pounder guns were sent to Gyangtse; and Lieut.-Col. Brander was directed not to assault the Jong, but to be sufficiently active to keep the enemy's attention concentrated on Gyangtse and off our communications. By the capture and occupation of a house, afterwards called Gurkha Post, on the 19th, the capture and destruction of Tagu on the 20th, the capture and occupation of Palla on the 26th, when Capt. S. H. Sheppard, R.E., and Lieut. J. A. Garstin, R.E. (killed), particularly distinguished themselves by breaching walls with explosives under fire from close quarters, and by various minor operations, the enemy were kept so busy that their only efforts were an attack on Kang Ma, by a force from Ralung at dawn on the 7th June, and one other threat on our communications, which by that time had been strengthened.

Meanwhile another period of intense strain fell on the Supply and Transport Services, as not only had the advanced troops to be supplied, but larger accumulations had to be laid in at Phari, Tuna, Kala Tso and Kang Ma to facilitate an advance in force to Lhasa. The weather on the upper plateau had improved; but early rains in the Teesta Valley and an outbreak of cholera (fortunately localised) handicapped the lower section of our line. By dint of special efforts, however, the necessary reserves of supplies were collected and distributed by the middle of June.

ADVANCE TO LHASA.

The third phase of the operations was the advance in force to Gyangtse and thence to Lhasa, the period from 13th June to 3rd August. During this phase the enemy's superiority in numbers was more marked; and their fighting men were better armed, more proficient in shooting and in tactical skill, and better led.

For the further operations reinforcements of 1½ battalions of Infantry (Royal Fusiliers, 23rd Pioneers, 40th Pathans) and 8 guns (of No. 7, British, and No. 30, Native, Mountain Batteries) were sent up; and as soon as these arrived in Chumbi Brig.-Gen. Macdonald's force set out for Gyangtse in two columns. The first comprised 125 mounted infantry, 1,450 infantry, 8 guns, 950 followers and 2,200 animals; the second consisted of 500 fighting men, 1,200 followers and 1,800 animals, and included the supply train. The leading column reached Kang Ma on the 22nd of June and the second arrived next day.

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The enemy had by this time collected a force of 16,000 men. They had several small cannon, some 30 jingals and wall pieces, and 800 breech-loaders, while the balance were armed with matchlocks. They were distributed as follows:—(1) At Niru, 15 miles east of Kang Ma and guarding the Kang Ma-Ralung road, 800; (2) at Niani, holding the Kang Ma-Gyangtse road, 800; (3) at Tsechan, guarding the Gyangtse-Shigatse road, 1,200, with a support of 2,500 men at Dongtse; (4) at Gyangtse 8,000; (5) at Gabzi, 18 miles east of Gyangtse and guarding the Lhasa road, 1,200. All these bodies held strongly fortified positions, and a further force of 1,500 was at or *en route* to the Kharo La, which was also fortified. Thus, though the enemy had a great numerical superiority, they were so distributed as to facilitate their being dealt with in detail.

On the 23rd June 500 infantry, with 2 guns and 50 mounted troops, attacked Niru; the defenders hastily withdrew and retired over the Se La instead of to Ralung. The same day the outlet of the Zamdang gorge was occupied with 250 men who entrenched themselves. On the 24th the first-named detachment rejoined; and next day the march on Gyangtse was resumed, the Tibetans being located in a strong position at Niani, where they had been reinforced from Gyangtse. On the 26th the enemy were driven from Niani after a sharp action, in which a portion of Lieut.-Col. Brander's force participated and there was some queer fighting in the dark passages and cells of the monastery. Gyangtse was reached on the same day.

In order to open the fertile Shigatse valley to our foraging parties, the Tsechan position was attacked and carried on the 28th, the success being due to thorough co-operation between the artillery and infantry; this caused the force at Dongtse to retire on Shigatse, while some 2,000 of the enemy also deserted from Gyangtse Jong, to which attention was next directed.

Gyantse lies in a small fertile plain at the intersection of four valleys; and consists of the Jong and the monastery, each on a rocky ridge, and the town, which hugs the base of the former hill and spreads into the hollow between the two. During May and June the Tibetans had laboriously strengthened the already naturally and artificially strong position by numerous sangars and traverses.

With a view to inducing the enemy to believe our main attack on the Jong would come from the north-west, the camp was removed on the 28th to the south bank of the Nyang Chu, and a bridge was commenced west of the town. Meanwhile the enemy sent in flags of truce, and futile negotiations followed until noon of the 5th July, when active operations were resumed. That afternoon a strong demonstration was directed against the north-west face of the enemy's defences, to confirm them in the idea that this was to be the direction of our main attack. Our troops pushed in and occupied some houses within 300 yards of the enemy's line, held their

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positions until after dark, and then, having lighted picquet fires, silently withdrew to camp.

At midnight the troops intended for the real attack on the precipitous south-east side of the Jong moved silently off, and were in their allotted positions at 3.30 a.m. on the 6th. The enemy had been misled by our demonstrations of the previous day; and when our three assaulting columns advanced against the town at 4 a.m. under cover of artillery fire, they occupied the houses under the fort with comparative ease, and had so strongly established themselves by the time the enemy could draw men from their north-west defences that they could not be dislodged. Late in the afternoon, the south-west curtain was breached by artillery, and the Jong carried by assault by Gurkhas and Fusiliers, supported by a concentrated fire of every gun and maxim. Though the monastery and greater part of the town were still in their hands, the enemy fled during the night, mostly towards Shigatse, and their force at Gabzi retired hastily on the Kharo La. A flying column, despatched down the Shigatse valley for supplies, found both Dongtse and Penam Jong evacuated, and returned to Gyangtse with large stores of grain and meal.

An advance on Lhasa was now imperative; and on the 14th July a force, consisting of 200 Mounted Infantry, 1,900 Infantry (Royal Fusiliers, 8th Gurkhas, 32nd Pioneers, and 40th Pathans) and Sappers, 8 guns and 6 maxims, with 2,000 followers and coolies and 3,900 animals (mules, yaks and donkeys) carrying 23 days' rations, marched out. A garrison of 8 companies Infantry (23rd Pioneers), 50 Mounted Infantry and 4 guns was left to hold Gyangtse.

On the 16th, after marching in daily rain, the column reached Ralung, and ascertained that the Kharo La (16,600 feet) was strongly fortified by a wall extending to vertical cliffs at the snow line and by sangars on every prominent point.

On the 18th, the pass was forced after slight resistance, the bulk of the enemy having fled during the night. The engagement was chiefly remarkable for the great altitude (18,500 feet) at which our troops had to fight, and the retreat of the enemy over a glacier, up which the Gurkha flanking party had to cut steps with their *kukries*.

On the 19th, Nagartse Jong was occupied without resistance, and here the force halted a day as the weather still continued inclement. Pede Jong was occupied on the 21st, and it appeared that the enemy were fleeing before us and devastating the already barren country. They, however, at last seemed to realize that refusal to treat would not delay the advance on Lhasa.

On the 24th July, we crossed the Khamba La (16,400 feet), and reached the Sang Po (or Brahmaputra), our mounted troops having that morning seized both the ferries. At Tamalung Colonel Younghusband received the first communication from the Tibetan

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National Assembly. On the 25th July we reached Chaksam ferry, where a missive was received from the Dalai Lama himself, and passed over the river a company of Mounted Infantry and seven companies of Infantry; as our guns could effectively command the north bank of the river, our position was quite secure. At Chaksam two great ferry-boats, large enough to hold 100 men, and a number of hide boats were found; with this providential aid, four Berthon boats accompanying the troops, and boatmen brought up from Attock in the Panjab, the passage of the whole force was completed in six days, the transport mules being swum over; during the crossing the Mission lost its Chief Supply and Transport Officer (Major G. H. Bretherton), who was drowned by the capsizing of a Berthon raft.

On the 31st July the advance on Lhasa was resumed. The enemy had fortified several positions, but abandoned all of them as we approached; and the force encamped before Lhasa on the 3rd August.

Posts had been established at Ralung, Nagartse, Pede Jong, Chaksam ferry and Tailung bridge, the garrisons of which, together with convoy escorts, absorbed 70 mounted men and 400 Infantry. As about 50 sick had also been left at posts between Gyangtse and Lhasa, our effective strength was reduced to 130 Mounted Infantry, 8 guns, 1,450 Infantry and Sappers and 6 maxims.

OCCUPATION OF LHASA AND WITHDRAWAL FROM TIBET.

The fourth and last phase of the operations included the occupation of Lhasa and the withdrawal of the troops after the conclusion of the Treaty.

The Lhasa valley is extensively cultivated, but does not produce sufficient for the requirements of the city and its monasteries, and the crops were not yet ripe, so that the food question soon became critical. The Chinese Amban and the Tibetan authorities promised supplies; but all the efforts of the Mission to persuade them to act up to their promises proved of no avail, and on the 5th August the troops had only 1½ days' rations in hand. No convoy from Gyangtse could be expected before the 29th, so strong measures were adopted, and on the 8th a force of 900 rifles with 6 guns moved out against the Daibung Monastery, which was said to contain 9,000 monks and have ample granaries. This monastery was selected mainly because it was the largest of the three great institutions which were reported to form the obstructive element in the Tibetan Councils. The monks were very obstinate, and it was not until the guns were in position and infantry had been ordered to advance that they agreed to our demands. Next day a requisition for a smaller amount was made on the Sara Monastery. Both monasteries satisfied our requisitions in full, and were paid at market rates for the supplies furnished. The

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demonstration against Daibung also stimulated the Lhasa authorities, and induced them to bring in sufficient supplies daily.

On the 12th August the Mission moved into the Lhalu Palace with a guard of two companies of Infantry, and the military camp was shifted to the driest site available in the marshy environs of the city.

Though the Tibetan authorities had withdrawn their troops from Lhasa itself, they retained them in small bodies in the neighbourhood; so constant reconnaissances were necessary. It was reckoned that, if a proportion of the monks could be induced to take the field, the Tibetans could within 24 hours assemble a force of 8,000 to 10,000 men. On the 13th August a reconnoitring party surprised a camp of the enemy and made 64 prisoners; on the 18th a reconnaissance northwards up the Kyi Chu valley effected the dislodgment of 600 soldiers from the arsenal. The activity of the reconnoitring parties induced the Tibetan troops to withdraw 20 to 30 miles from the capital, and thus reduced the tension.

The Dalai Lama had disappeared prior to our arrival; it was said he had fled to Mongolia, accompanied by the Buriat Dorjieff.

Meanwhile, as our departure might be delayed and low temperatures and snow were reported on the uplands between Lhasa and Gyangtse, arrangements were made for additional warm clothing and blankets for the troops.

It appeared likely that, in spite of durbars and diplomatic correspondence, the Tibetan authorities would protract their negotiations of a treaty so long as to necessitate the Mission remaining at Lhasa through the winter. The common people, however, were evidently thoroughly friendly, bore no malice, and fraternized with the troops, who were allowed daily in the city and bazaar; and one day largess was distributed to 11,000 of the poor. On the 1st September the British Commissioner issued what was practically an ultimatum. This had the required effect, and on the 7th a Treaty was signed in the Dalai Lama's throne room in the Potala Palace, the Guard of Honour escorting the British officials consisting of representative detachments of the Royal Fusiliers and of the Sikhs, Gurkhas and Pathans. The principal clause of the Treaty secured the preponderance of British influence in Tibet.

In anticipation of the withdrawal of the Mission the posts between Lhasa and Gyangtse were stocked with two or three days' supplies for the column; and on the 9th September the Sappers, one company of Infantry, the brigade coolies and 5 days' supplies for the Force were sent ahead to Chaksam, to arrange for the passage of the Sang Po. The upper crossing, Partsi, was found more suitable, and three ferries were extemporised.

On the 23rd the force marched from Lhasa in one column. On the 25th Colonel Younghusband, with the bulk of his staff and a small mounted escort, pushed ahead by double marches. On the 27th

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Partsi ferry was reached, and the excellent arrangements made by the Engineers enabled the whole force to be passed over by 2 p.m. on the 29th.

From Partsi to Gyangtse the force marched in two columns, leaving the former place on the 29th and 30th September, and arriving at Gyangtse on the 5th and 6th October. The supply arrangements at the posts were excellent, and the only discomfort was the low temperature (10 to 21 degrees of frost) at night. A survey party with an escort marched independently, and did some useful work between the Sang Po and Gyangtse. From Gyangtse the escort returned to India in smaller columns, picking up the garrisons of posts *en route*.

REMARKS.

In all the escort had 16 engagements and skirmishes in which we suffered loss, and the total war casualties amounted to 202, including 23 British officers, of whom five were killed.

General Macdonald attributes the comparatively small losses sustained in the more important actions to the thorough support afforded to the assaulting infantry by the artillery.

The engineering work of the escort comprised road-making (170 miles), bridging, hutting, defence of posts, siege works, demolitions, and heading storming columns with explosive parties. The General Officer Commanding records that the gallantry of the explosive parties was marked, and that the work of the Engineers, Sappers and Attock boatmen at the crossing of the Sang Po River was excellent.

The important work of the Supply and Transport Department was carried out under extraordinary difficulties in a way that justly merited the admiration of all. In the unhealthy Teesta Valley one form of disease after another seized the transport animals in spite of every precaution. During the winter the transport service had to be maintained over the passes in spite of intense cold and constant gales and snowstorms. On the barren uplands of Tibet there was one long sustained struggle to provide grain, fodder and fuel. A variety of animals were tried—camels, buffaloes, bullocks, yaks, mules, ponies and donkeys— ; and also coolies (local men as well as Baltis and Ladakhis from the N.W. Himalayas) and the light two-wheeled ekka carts. Ultimately, the stage from Siliguri to Gantok was worked by bullock carts ; ekkas ran over the Phari Jong-Tuna plateau to Kang Ma ; the regular transport mules were the mainstay from Gyangtse to Lhasa ; whilst yaks supplemented the other means on many stages, and coolies were employed over the most difficult passes.

The peculiar climatic and physical conditions threw an additional strain on the Medical Department.

At Chumbi (9,700) the mean daily temperature at 9.0 a.m. from

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July to October inclusive was approximately 55·75° F.; at Phari (14,300) and Tuna (15,300) about 28° F. of frost occurred almost nightly from the middle of October to the middle of March; at Gyangste (12,900) the mean daily temperature from April to September inclusive was 55·9° F., the minimum being 25° in April and May and the maximum 89° in May, June and July; the lowest recorded was—18·4° F. on the Tang La (15,700) on the 7th January. At Chumbi the average rainfall per mensem from February to October inclusive was about 5·25 inches, the maximum being 7·69 in April; during the march to Lhasa and the stay there heavy rain fell almost daily, and the soil at Lhasa was practically waterlogged. Excluding war casualties, the total numbers of deaths and of men invalided were 411 and 671; of these, 202 and 405 respectively were more or less due to the special climatic conditions. In addition to the above, 160 of our wounded had to be cared for, and a large number of Tibetan wounded also received medical attendance. Most of the sick casualties occurred from dysentery, diarrhœa, pneumonia, frost-bite, snow blindness and mountain sickness, the three first accounting for nearly half the deaths. Five deaths in all occurred from frostbite, and 45 men were invalided; in one day in March 50 cases of frost-bite and 70 of snow blindness occurred in one small convoy; and during the return journey, in two days' marching after a heavy snowstorm, there were 200 cases of snow blindness in a total strength of 2,500 troops and followers. Nineteen men died and 18 were invalided from heart affection due to mountain sickness, and a considerable number died suddenly from syncope whilst weakened by other diseases. There was little enteric fever, but many cases of severe continued fever occurred between Phari and Gyangtse; malarial fever was common in the Teesta valley and Sikkim.

The Survey Department succeeded in mapping a large extent of practically unknown country and the geographical results are likely to be most valuable. In addition to about 300 miles of route sketches (one inch to one mile), some 20,000 square miles were mapped, including large scale surveys of the country round Chumbi, Gyangtse and Lhasa. A proposal that a party should trace the Sang Po down-stream, and definitely prove its identity with the Brahmaputra of Assam, fell through; and the opportunity was also missed of investigating northwards in the direction of the Tengri Nor to connect up with the explorations of Sven Hedin. But Captains C. H. D. Ryder and H. Wood, R.E., with a small escort, were despatched up the Sang Po to examine Western Tibet as far as the sources of the Indus and Sutlej.

The Line of Communications was a long and difficult one, the distance from Siliguri to Gyangtse being 225 miles and from Gyangtse to Lhasa 145. In all some 30 posts had to be maintained, five of which were in the unhealthy Teesta Valley and seven were approxi-

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mately 15,000 feet above the sea. Up to the end of the second phase no special officer was sanctioned to command communications; but during the third and fourth phases Colonel H. Read, 4th Rajputs, had charge of the line from Siliguri to Ralung.

The Field Post service had many difficulties to contend with. From Siliguri to Tuna the mails were carried by the Postal Department, and thence to Lhasa by military agency. Up to Gyangtse a daily service was maintained latterly, and from there to Lhasa mails were carried by Mounted Infantry every three days.

In the first phase of the operations the Telegraph accompanied the force and the line was extended from Sikkim to Phari; during the second phase the line was continued to Kala Tso; and in the third phase it accompanied the force to Gyangtse.

The operations threw a very great deal of extra work on the Public Works Department, both in the Teesta Valley and in Sikkim.

The Maharajah of Nepal and the Nepal Durbar offered substantial help in the matter of transport. The Raja of Sikkim placed the resources of his State, both in men and animals, at our disposal; and a locally raised Cooly Corps (organized by Mr. J. C. White, Political Officer, Sikkim) worked over the Nathu La pass from January till the end of the operations.

His Majesty the King-Emperor signified his appreciation of the work of the Mission by granting a special Medal, with a clasp for Gyangtse.

The present writer has borrowed freely from General Macdonald's final Despatch, and is also indebted to Mr. E. Candler's *The Unveiling of Lhasa* and to the *Journal of the Royal Army Medical Corps.*

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CONTROL OF TRAIN MOVEMENT.

By Capt. C. E. Vickers, R.E.

In recent American practice, while much stress is laid on the attainment of greater safety in running than was formerly the case, a principal aim is the provision of as great elasticity as possible in arrangements for the movement of trains, and as absolute a control as possible of the workings.

In this American Railways fundamentally differ in their methods from those in vogue in English practice, and it will be seen that there is little tendency to assimilate their methods of controlling traffic to those which are familiar on this side of the Atlantic.

The system of concentrating the control of movement of trains in the hands of the Train Despatchers has grown up gradually from primitive beginnings, and has now been systematised to a degree of great exactitude.

An examination of actual practice appears to indicate that the system affords a means of effecting great savings in running time, and corresponding economies in working cost.

A consideration of the "Train Despatching" system seems to me to be of peculiar interest from a Military point of view. English methods are mainly adapted to lines where the density of traffic is great, and, safe working being an all-important consideration, involve a number of restrictions which have as yet not much counterpart in America. Under War conditions, and on lines where the normal traffic is sparse, it is likely to be of paramount importance that there should be as intimate a control of movement of trains and distribution of rolling stock as is possible of attainment.

It may be that on a comparatively short line the irregular running of trains can be kept in fairly close check; and that, where the traffic is heavy and the line is laid out for heavy traffic, the relative disturbance of the schedule by, say, one train running out of course is of no great moment; but it might be this one train which it was desired to expedite. In such cases the more direct the means available for the transmission of orders the better. Under War conditions, again, it is seldom possible to look far ahead, or arrange any programme which may not have to be modified at short notice. It is then advantageous to be able to control the movement from Section headquarters,—a measure of centralisation which would very well correspond with the system of Military control. It will be seen,

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however, that while Section headquarters of the Railway are kept constantly informed of what is happening, the normal working is not interfered with except when circumstances render it desirable, and a constant reference from Stations to Section Headquarters is not necessary before taking action.

The principle underlying the system herein described is an absolute adherence to Timetable under normal conditions, but modified when necessary by the Train Despatcher's power (he being conversant with the position and running of *all* trains on the Division) of re-arranging the workings and altering the Schedule times or Crossings.

Again the precedence of all trains is definitely determined, and this precedence can only be altered by Orders from the Train Despatcher.

In order that a control such as this may be exercised, it is necessary that a complete system of reporting trains should exist; but, as a matter of fact, this does not involve any complication, provided telegraph facilities are adequate.

It may here be remarked that :—(1) the system does not involve the installation of any costly or elaborate apparatus apart from that appertaining to the Block signals ; (2) it does not supersede or dispense with the protection of trains by Block signals, which are now being installed generally, but it can be and is operated without Block signals on the lines of sparse traffic, *e.g.*, crossing the Western Plains.

Through the courtesy of Mr. W. H. Truesdale, President of the D.L. & W.R.R., and of Mr. W. G. Besler, Vice-President and General Manager of the C.R.R. of N.J., I have been able, during a recent visit to the United States, to examine in detail the working of the "Train Despatching" system on these two up-to-date lines,* and have written a few notes on this method of control, which is, as stated above, particularly well suited to the needs of Military service, but, as will be pointed out, demands a highly skilled and trained staff of Despatchers and Telegraph Operators.

ORGANISATION.

The Superintendent of a Division is, as a rule, in charge of all matters affecting Operation; that is, he controls the movement of trains and all staff concerned therewith (including Loco. men when on the road), the maintenance of Way, telegraphic and Signalling

* The New Jersey Central use absolutely the Standard Rules, their Telegraph Superintendent, who shewed me their methods, being a member of the Standard Rule Book Committee and an ex-Train Despatcher of great experience: the Lackawanna road has a heavy traffic, but many of its principal officials have come from Western lines, such as the Burlington and Rock Island, so that I was there able to obtain information as to points specially arising in single line working.

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arrangements, and so on. There is at present a tendency to revert to Departmental organisation as regards Maintenance, but the placing of Loco. men under the Superintendent's orders while employed on Transportation has a good deal to recommend it.

Station Agents are not intermediaries in arranging movement of trains. Their duties end where transportation begins, and they have primarily to do with the commercial side of the business, up to the stage where the traffic is handed over to be moved. They are in charge of Station premises of course. As will be seen later, at a large Station the Agent has to requisition on the Yard Master for any movement of Cars he requires.

The Telegraph Operators are responsible for due and correct passing of Orders as regards movements, under the orders of the Chief Train Despatcher of the Division.

In practice it is essential that every Despatcher should be an operator, and in fact it is from the ranks of the Operators that the Despatchers are recruited (Conductors and other Train men do not necessarily learn telegraphy). But the qualifications of a Despatcher are not easily found; he must have in him the embryo of a Superintendent; he has to be accustomed to carry in his mind the position of all the trains, and to forecast the modifications of the running which may be necessary, based on the running of the trains concerned and the nature of the load, the weather, power of engine, train men, and all the thousand and one considerations which are always present.

Finding men suitable for the office of Despatcher is, in fact, the ruling difficulty which would arise in improvising such a system of train control.

It must not be forgotten that the arrangement of trains on a single line is necessarily more complex than that on a double line.

The arrangement of Meetings is facilitated by the way the "Train Report Sheet" is printed. It shews Down trains running down the column, and Up trains of the same section directly below and up the column (*i.e.*, the names of Stations run the same way—opposite the name of each Telegraph Station is printed its "Code"). Thus the approach of trains to one another is graphically indicated. This arrangement provides a safeguard against arranging Meetings to overlap.

TIME TABLES AND TRAIN REPORTS.

For the original compilation of Timetables large scale time and distance diagrams are employed (*cf.* p. 196, *Instruction in Military Engineering*, Part VI.), the trains being indicated by threads of different colours according to Class. Pins are driven in at intersections, which must occur at Sidings or Stations; these are the Meeting or Passing points.

Once the Timetable is completed, however, it is printed and the

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diagram not further used, as the Despatcher, from constant association, knows all the trains without reference to diagram, and finds no difficulty in mentally arranging modifications without the need of using the diagram.

In the printed Timetable Meeting or Passing points are indicated in heavy type (but no specific references are made to the trains to be met or crossed) and trains of different classes are shewn separately—an arrangement for which I did not obtain any reason.

The trains are numbered Odd for Down, or Westbound, and Even for Up or Eastbound, and similar series numbers are allotted to trains of the same category, *e.g.*, Through Expresses, Milk trains, trains for the same destination, and so on. (I may here remark that the system of carrying distinctive Headlights to indicate Class does not seem to be employed, though special lights and signals are carried to notify Duplicates and so forth).

Extra Trains, *i.e.*, Specials, are identified by the number of the Engine. A duplicate is known as a Second Section, and so on, and would be called (for example) 1st 21, 2nd 21, if train 21 is run in sections.

Times of arrival, departure and passing are reported from nearly all Telegraph Stations or Signal Towers (Register Stations). These are immediately entered, as received on the Sounder, on the "Train Report Sheet."

Each Despatcher keeps his own Train Report Sheet, which covers all lines and branches controlled by him—an amount naturally dependent on the density and complexity of the traffic.

There will be several Despatchers to a Division, each of whom comes on duty for eight hours at a time and is continuously at work for that period.

When the Despatcher takes over he signs the Report sheet and initials a book to the effect that he has been informed of all orders in force and so on.

The control of movement of trains on a Division is in fact very intimate and concentrated in the hands of the Despatchers. The Train Master is the Superintendent's subordinate in charge of Train men of all Departments while on the road, as well as of Yards and Switching. The Chief Train Despatcher is entirely in charge of the movement of trains. Under him are several Despatchers, who each have direct charge of a section. These men are in telegraphic communication with all the Telegraph Stations of their sections: all stations of the section are on the same circuit, and the Despatcher actually has the operating key before him and sends and receives all messages himself. Under English practice, now, there is no immediate and direct constant control of the running of trains from headquarters. In fact, the Trains office of a Division (or District) does no more than make arrangements for the running of trains, and

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once a Train is "arranged" the further control of its movement rests with the local officials. In many cases arrangements exist for constantly reporting the running times forward, but there is no machinery for modifying the scheduled times at short notice should such a thing be expedient. This may partly be due to the fact that making up time is discountenanced.

It is to be remarked, however, that the recent appearance of an article about the possibility of adapting "Train Despatching" to English working, in the *Great Western Railway Magazine*, shews that there are those who recognise that more central control might be of value.

In America it is usually the practice, in revising a train's schedule by Order to suit the amount it is reported as running late, to assume that a certain amount of time will be made up. If the time is not made up a fresh Order can be issued revising the times.—*E.g.*, a train is delayed by a breakdown ; as soon as this news comes in, an Order is issued on the assumption that it will run, say, two hours late ; this amount is found to be insufficient, and a fresh Order is made scheduling it three hours late, and so on.

Messages between the Despatcher and the various Operators are not recorded except in the case of Orders. It does not appear to be the practice to record trains in the Signal Boxes. (This refers, of course, to a line where Automatic Block signalling is in operation).

If all trains are running according to schedule, all the Despatcher has to do is to note up the running reports of trains on his Sheet (times of arrival and departure, number of train at head of column, train load, names of Driver and Conductor, and other special information), except as regards arranging meetings, as will be shewn in the case of single line.

Directly a train begins to run out of course, however, his special functions begin to come into play. As the reports come in, he considers what modifications of the fixed times, etc., can be made with a view to improving the running. As soon as the situation is ripe he then issues an Order. This Order is repeated in identical terms to all trains concerned and to such yard masters and others as are likely to be able to take advantage of it by getting off trains which must otherwise wait.

Such an order may modify running times, Crossing or Passing places, notify the running of extra trains or duplicates, annul or alter the precedence of trains, and so on.

As regards precedence, all trains are classified, and have certain Rights for the purpose of determining which should have right of track and which should be allowed to pass ahead. The inferior train must always keep off the time of the superior train. The train men know what other trains are on the track, for they have to count on all scheduled trains unless they have received any Orders to the contrary,

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and the scheduled trains are only modified to such extent as standing Orders (issued by Bulletin) or Orders from the Train Despatcher determine.

As a rule East bound trains have precedence over West bound, and Passenger, Freight, Work trains, etc., have rights in the order named. Sections have the same rights as their first portions; and any special rights given to an extra train are notified in the Order advising its running, otherwise it is inferior to regular trains. Running a train in sections is simpler than arranging an extra, as the precedence is thus immediately determined.

It is the rule that an inferior train must keep five minutes off the time of a superior train, but no train may arrive at a station before it is due, nor leave before due time.

If a train stops or is delayed under circumstances where it might be overtaken by another train, the flagman (who is one of the train men) must go back a sufficient distance to protect it. He can be recalled by a whistle signal. The whistle is used principally for communication with the train men, not for signalling to junctions, etc.

ISSUE OF ORDERS.

The Telegraph Operator at a Station, upon receipt of the Order prefix, puts up his Train Order Signal (this is a semaphore signal of special pattern with pointed end). A copy of the Order is given to the Conductor and Driver, and in certain cases the Order has to be signed before any action may be taken on it, as will be explained further on. The Train Order Signal is displayed until the train for which the Orders are issued arrives. If there are no Orders for a train stopped (being first to arrive), the Operator gives it a "Clearance Card" and it proceeds on its way. Two kinds of forms are used for Orders—a "19" form (green), and a "31" form (yellow). The former is handed by the Operator to the Train men as they pass; but the latter requires signature before it is "complete," and the train must therefore stop. As the train approaches, the Operator being ready and holding up the form to view, the Driver immediately knows from the colour whether he must bring his train to a standstill or not, if it is not a scheduled stop.

The Rules lay down that the Conductor must read the Orders to his brakeman and the Driver to his fireman.

In giving an Order the Despatcher indicates its nature by the prefix 19 or 31. With the prefix is indicated the number of copies required, *e.g.*, "19 copy 5," and the corresponding number of copies is then taken off with carbon paper. If sufficient cannot be struck off at one writing, additional are traced from one of those first made (to avoid any mistake in copying). The paper used is very thin, and waterproof.

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The Order is always repeated to the Despatcher immediately it is received, from the copy written for issue, except when the engine of the train for which the order is intended has passed the Train Order Signal. In this case the Order must not be repeated back until the Conductor and Enginemen have been notified that there are orders for them. This is to ensure that a train, which, say, has drawn ahead into a siding, does not go away without receiving the Orders, and that the Despatcher does not assume an Order "complete" which has not duly reached the Train.

The Despatcher then enters it up, at once as repeated, in a book of forms provided for the purpose, and not until he acknowledges it as correct ("complete") can it be acted on.

The signal "X," which precedes an Order, signifies "train must be held until the Order is complete." In certain cases, when "X" has been acknowledged, the repetition of the Order is omitted, if delay to the train can be saved in this way. This would not be done in the case of Meetings. In each case the time at which the Order is made "complete" is shewn on the Form, and noted in the Book.

The names of the Conductor, Driver, Operator and Despatcher also appear on the form.

The portion of the form for the Order itself does not contain any printed words, as the nature of the Orders may vary a good deal, though specimen wordings for all the usual types are provided in the Rule Book.

The "19" form of order is used in ordinary cases of modifying passing times, etc.; the "31" form when the train to which it is addressed has its superiority in any way restricted thereby, also for arranging Meeting places on the single line.

A "Clearance Card," which is a certificate that there are no further orders for the train than those already carried, is given:—(1) to a train leaving the Terminus and running on Schedule according to its rights—thus not requiring any Orders until any modification of his schedule is required, (2) to a train stopped by a Train Order Signal exhibited for another train.

As an example of the functions of the Train Despatcher:—Train No. 1 (First Class) is reported from a Station beyond the Division as running ½ hour late. Normally all other conflicting trains of inferior class must keep off the times of this train, and would consequently have to wait at the scheduled meeting or passing places, or their equivalent supposing any of them are behind time. Therefore an Order as follows may be issued:—

No. 1 will run 25 min. late Joppa to Mainz, and 20 min. late Mainz to Muscat.

This Order is addressed to all trains affected—the Despatcher sees from his Report sheet what and where they are, and enters up in the space provided on the Form when made "Complete" as regards

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each—also to Yard masters concerned, *i.e.*, at any collecting stations where trains are made up which this train would pass. Any trains so sent off will be reported directly they start on their journey, and of course cannot start without Orders if "Extra." Should train No. 1 lose more time a further order can be issued, so as to give the trains affected an increased margin of time.

ARRANGING CROSSINGS, SINGLE LINE.

On single lines no train is allowed to run without carrying an Order; but in the case of Passenger trains the only Order carried, except under special circumstances, is the "Clearance Card" which starts the train on its journey. As Orders are not exchanged, and as the passenger train will have precedence over all others of inferior class, there should, supposing it runs according to schedule, be no need for any fresh Orders to be given it at points along its journey. It must not be forgotten that where there are signals these Orders are not primarily for the purpose of securing the safety of trains, but for regulating their running. A train is always given Orders to take it as far as possible on its road.

The type of Order then to be issued for a train moving on single line will be :—

No. 5 *will meet No.* 3 *at Bombay 2nd No.* 10 *at Siam and extra* 95* *at Hong Kong.*

INTERMEDIATE SIDINGS.

Where there are intermediate sidings between Telegraph Stations, it is obvious that no message can reach the trains there unless carried by a meeting or passing train, after the train concerned has left the telegraph station. The Despatcher must therefore watch the running of all trains up to the last telegraph Station carefully, and take care to issue any Orders which may be required to modify schedule times or rearrange meeting points before the trains concerned get beyond telegraphic reach.

No matter what precedence trains have, their running, when in opposing directions, cannot be altered from that scheduled except by Order of the Train Despatcher; and in the same way meetings once arranged by schedule or by Order cannot be altered except by a fresh Order.

If a Train Order is to be delivered to a Train at a point not a Telegraph Station (or where the Telegraph Office is closed), it is addressed to "Conductor and Engineer of ——, c/o the person who carries it."

On the "31" form "complete" is then given on the signature of the person who carries the Order, who is responsible for obtaining

* N.B.—This is the Engine number.

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signature of the train men concerned, on a copy given him for the purpose. This copy completed he hands in to the first Operator accessible, who retains it and immediately telegraphs the signature of the Engineer and Conductor to the Despatcher.

If such an Order restricts the superiority of the Train to which it is directed, "complete" must not be given to the inferior train until the Conductor's and Engineer's signatures have been wired back.

It is thus evidently necessary to take full precautions to ensure that an Order limiting the superiority of a train is obeyed.

WRECKS AND OBSTRUCTIONS.

Should the occurrence of a Wreck, or Engineering work in progress, necessitate any modification in the running of trains, the control of movement still remains in the Despatcher's hands, and no attempt is made to localise it at the place where traffic is hung up.

The Train Despatcher in fact, by virtue of the system which reports the running of trains to him, must be better acquainted than anyone else with the general situation and what can be done as regards rearranging trains.

The Superintendent, or Train Master, or whatever official gets to the spot first, therefore puts himself in telegraphic communication with the Despatcher as soon as possible, and keeps him constantly informed how things are progressing until the normal working can be resumed.

Conductors are empowered to call upon trackmen, etc., and men of other trains, so long as it does not interfere with their due protection, for assistance in case of a wreck.

ROLLING STOCK DISTRIBUTION.

The Chief Train Despatcher of a Division is responsible for seeing that the requirements of Stations for Rolling Stock are duly fulfilled.

Stations render to this office a daily return of trucks under load and empty, shewing also how long on hand. Formerly it was the practice to compile from this a general distribution sheet, on which any orders might be based. On those lines whose working I saw, however, this has been abandoned, and it is deemed sufficient to work empties to the nearest distributing centre or large yard, whence any requirements of minor stations can be met. Arrangements for keeping Car record at headquarters, shewing position of each Car from day to day, are not in force, although detailed reports of the composition (not truck numbers) of the more important freight trains are wired forward, so that it may be seen whether it is advisable to quicken the running of any particular train; and elaborate arrangements are in use for keeping record of the position of each Car in the Terminal yard.

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If enquiry is to be made as to the position of any particular Car, its number can be turned up without any great difficulty in the Station reports.

As regards demurrage, (the above reports shew number of days standing under load), Car service Associations have done much during recent years to eliminate delays by Rolling Stock standing idle, but the system still obtains of allowing so many days free for the completion of the journey before hire is charged.

Private owned cars are not very numerous, and appear to be chiefly Refrigerators belonging to the Meat Companies and so forth. This partly explains how so much standardisation has been reached in the pattern of cars.

TRACING OF CARS (HOBOKEN YARD).

The system in force at this Station seems to be local, but is interesting.

On arrival of his train, the Conductor hands in his Vehicle List, which shews particulars of Cars and nature of load, at the Yard Master's office. From this a list is made with, against each car number, the number of the road where it should normally be placed. The cars are chalked accordingly, and the train distributed by the Yard men.

Meanwhile entries are made in a Car Index book (indexed by the terminal figures of the number, and shewing home owned and foreign cars on separate pages; tags facilitate turning up any particular number). The date, time of arrival and train (number of engine) are shewn against the Car, and road where placed.

A copy of the Vehicle List is sent to the Freight Agent, who requisitions on a Form for the placing of the Car where required for unloading, etc. It will be observed that this is in accordance with the principle that the Agent does not control movement, even in the Yard. This list is passed out to the Drill Master (Foreman Shunter), who works with a "Drill" engine and gang of men. There will be several of these crews in a large yard. As each shunt is made, he fills in on a slip where the Car is placed. Subsequent movements of the car are similarly noted and reported, and finally the particulars of the train removing the car are noted up.

Thus each group of entries shews the whole particulars of the disposal of the car, and the position of any car enquired after can be turned up at once.

The number of printed forms used is rather large, and in fact this feature strikes an outsider a good deal. It appears as if it were the the idea to reduce these things to routine as far as possible and eliminate verbal instructions, to get rid of the possibility of dispute and to avoid sending messages. Clerical labour is comparatively cheap.

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As a rule Invoices or labels are not attached to the car. A card way-bill is, however, made out for each car as soon as ready to go, and these are given to the conductor to make up his train from, or the Drill crew can equally make up the trains and so save the train engine being brought out before due for departure.

In the office these cards (Way bills) are sorted together in a rack. Different colours shew foreign cars, so that the traffic for any particular destination or train can be picked out at a moment's notice, and the making up of through trains facilitated. A watch can also be kept on cars whose return is urgent. The Yard master can in fact see what he has ready for despatch without leaving his office. This, to my mind, is very characteristic of American Railway practice: the great idea always seems to be to have information tabulated or collected, so that there is no need to stir out of the office or to go and see personally, when it is desired to see how anything is getting on.

The invoices, shewing charges, are sent from Agent to Agent. Movements of trains in the passenger Yard are directed by the Yard master, who gives any necessary instructions to the Signalman in the Signal tower by telephone, and gives similar orders to the Drill master as regards the making up of trains. Engine whistles to ask for roads to be set do not appear to be much used.

In the case of passenger trains of course the making up and shunting to be done is practically the same from day to day. The same trains start as far as possible from the same roads every day.

AUTOMATIC SIGNALLING.

Automatic signalling is being extensively adopted in the Eastern States, and in principle seems to be peculiarly adapted for combination with such a system of train control as has been outlined. The signals *indicate* whether the section in advance is blocked or not, and the Signalman is no longer required as a directing agent, as the directing power is concentrated in the person of the train Despatcher, and the Operator, who is the medium for passing on the Orders, has thus in this matter no *executive* functions.

At Junctions and Shunting Yards (*vide* previous remarks), for such switches as are not turned by hand and main line connections, there are of course signalmen, and probably the Signal Tower also includes a Telegraph Station; but as a rule the working of signals and switches would be independent of "Train Orders," and the train men would, apart from signals, be responsible that they carry such Orders as are required under the system.

Under the "Normal Safety" system the signals do not go to the "on" position until the line is blocked by a train or otherwise, while under the "Normal Danger" system the signal remains "on" until

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the train approaches. The Distant Signal has a yellow arm and repeats the Home signal on the post in rear.

The signals vary somewhat in their spacing—I refer to the Electro-pneumatic system, but the same will apply to all automatic arrangements—but do not as a rule exceed 1,200 yards apart, so I was informed. This length is convenient enough where traffic is heavy, but does not allow much distance in which to pull up a fast train.

If the signal is at "Danger," the Driver must bring his train to a stand, but is not compelled to wait till it comes "Off." He must wait one minute, and may then proceed, with his train under control, to the next block signal. This is not, therefore, an absolute Block System; but, seeing there is no human agency to operate the signals, some loophole must be provided to prevent a series of trains being blocked by the vagary of an erratic signal. If anything goes wrong with the apparatus the signal should go to the "On" position. It is stated that the installation of these automatic signals has greatly diminished the number of head and tail collisions.

In some cases an automatically signalled line is used for traffic in both directions. In such case it is signalled both ways. I was unable to ascertain the arrangement of electrical connections, but imagine it must be more complex than where provision has only to be made for traffic in one direction.

The semaphore type is now replacing others, *e.g.*, the Banjo pattern, which although working satisfactorily, do not give so visible an indication to the approaching train and are liable in some patterns to be masked by snow. Red and white are the colours used for Home signals (Specs), Green and White for Distant signals. Pot signals or Ground Discs as Switch indicators shew blue for "On" and Green for "Off," as it is considered that these colours are least liable to lead to confusion.

September, 1904.

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STEEL CONCRETE BEAMS.

By LIEUT.-COLONEL J. WINN, LATE R.E.

IT may be of interest to those who are undertaking steel concrete construction to know of a very simple formula, which has been deduced in America, as a result of most careful and thorough investigations on large beams.

It was found that the reinforcement failed rather than the concrete as generally used (viz., 1 part of 1 cement and 3 sand to 6 parts broken stone), which was amply strong to resist the compression to which it was subjected; and, consequently, if the reinforcement was sufficient (with due regard to economy of metal), the results agreed with the formula.

$$M_r = (0{\cdot}9 - \tfrac{1}{15}\, p)\, A\, s\, d,$$

where p = % of steel of beam bd,
A = area of steel,
s = stress per unit of steel,
d = distance from top of the beam to centre of the steel.

The results support the conclusions arrived at on page 38 of *Notes on Steel Concrete*, 2nd Edition, where the resistance of the *concrete* is chiefly considered if 2 per cent. of steel is used as recommended, a recommendation which has been endorsed by American practice before and since;

for, taking $\frac{1}{6}\, r_c bd^2$ and equating it with the formula given above for 2 per cent. of steel at $6\frac{1}{2}$ tons,

we get $$\tfrac{1}{6}\, r_c bd^2 = (0{\cdot}9 - \tfrac{1}{15} \times 2)\, \frac{bd}{50} \times 14500 \times d$$

from which $$r_c = 1340 \text{ lbs. per sq. inch};$$

and though this is 3 times the value of r_c usually taken, it has been found by the experiments cited above that the concrete did not fail.

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STANDARD SPECIFICATION FOR PORTLAND CEMENT.

APPROVED BY THE ENGINEERING STANDARD COMMITTEE.

(*Condensed Extract from* THE BUILDERS JOURNAL, *January 18th*, 1905).

BEFORE testing, sample to be spread out 3″ deep for 24 hours in temperature 58° to 64° Fahr.

Fineness.— 3% residue on sieve 76 × 76 (5,776 per sq. in.).
22½% „ „ 180 × 180 (32,400 per sq. in.).

Specific Gravity.—3·15 at works, 3·10 after delivery.

Chemical Composition.—Proportion of lime to silica and alumina not greater than ratio 2·75 to 1.

Insoluble residue not to exceed 1·50%.
Magnesia „ „ 3·00%.
Sulphuric anhydride „ 2·50%.

Water in Gauging Briquettes.—Sufficient to form a smooth, easily worked paste that will leave trowel in a compact mass; no mechanical ramming. Temperature of room 58° to 64° Fahr.

Briquettes to be removed from mould after 24 hours and to remain in water until testing. Temperature as above.

Tensile Test.—

(1). Neat Cement Briquettes 7 days, 400 lbs. per sq. in.
„ „ „ 28 „ 500 lbs. per sq. in.

Increase in 7 to 28 days to be as follows:—
At least 25% when 7-day test falls between 400 and 450 lbs.
„ „ 20% „ „ „ 450 and 500 lbs.
„ „ 15% „ „ „ 500 and 550 lbs.
„ „ 10% „ „ is 550 lbs. per sq. in. or upwards.

(2). Cement and Sand briquettes to be gauged 1 to 3 with dry Standard Sand (Standard Sand from Leighton Buzzard, washed and dried, to pass through a sieve 20 × 20 meshes and be retained by sieve 30 × 30 meshes).

Briquettes to stand 120 lbs. per sq. in. after 7 days.
„ „ 225 lbs. „ „ 28 „
The increase from 7 to 28 days not less than 20%.

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Setting.—

Quick-setting cement, 10 to 30 minutes.
Medium „ „ 30 min. to 2 hours.
Slow „ „ 2 hours to 5 hours.
Needle to be $\frac{1}{16}$in. square in section and weight 2½ lbs.

Expansion.—

(1). Fill gauged cement into split metal cylinder 30 millimètres diar. and 30 millimètres high, and place in water (temperature 58° to 64° Fahr.) for 24 hours.
(2). Measure distance between indicator points.
(3). Place mould in cold water, bring to boiling point in 15 to 30 minutes, and boil for 6 hours.
(4). Measure distance between points after boiling.
The difference between the two measurements equals expansion of cement, which must not exceed 12 millimètres after 24 hours aeration or 6 millimètres after 7 days aeration.

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We have been requested to state that the word "New" should be substituted for "Experimental" in the heading of the article containing particulars of Horse and Field Artillery Equipments (page 129).

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EXPERIMENTAL HORSE AND FIELD ARTILLERY EQUIPMENTS.

PARTICULARS AS TO WEIGHTS, ETC., OF 13-PR. AND 18-PR. Q.F. GUNS.

Particulars.	13-pr.	18-pr.
Muzzle Velocity	1658 f.s.	1610 f.s.
Calibre	3 inches.	3·3 inches.
Weight	6 cwt.	9 cwt.
Breech Mechanism	Swinging Block.	Swinging Block.
Rifling { Grooves, Number ...	18	18
Rifling { Twist	Uniform.	Uniform.
Firing Mechanism	Percussion.	Percussion.
Approximate weight of gun and carriage	Cwt. qr. lb. 18 0 12	Cwt. qr. lb. 23 3 3
Approximate weight of carriage limber	12 0 0	14 3 3
Approximate weight behind traces	30 0 12	38 2 6
No. of rounds in carriage limber	24	24
Approximate weight of wagon (filled)	Cwt. qr. lb. 15 1 21	Cwt. qr. lb. 19 1 14
Approximate weight of wagon limber (filled)	14 1 27	18 1 16
Approximate weight behind traces	29 3 20	37 3 2
No. of rounds in wagon limber	38	38
No. of rounds in wagon ...	38	38
Height to axis of Gun from ground	3 ft. ·86 in.	3 ft. ·86 in.
Wheels { Track	5 ft. 2 in.	5 ft. 2 in.
Wheels { Height	4 ft. 8 in.	4 ft. 8 in.
Weight of projectile (filled and fuzed)	12½ lb.	18½ lb.
Ammunition	Fixed and fitted with percussion primer.	Fixed and fitted with percussion primer.

WAR OFFICE (A. 2),
6th February, 1905.

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TRANSLATIONS.

DISTANT EFFECTS OF DYNAMITE.

Probably few of us go in fear of the consequences which might result from the explosion of the large quanties of dynamite sometimes stored; but if there are any who desire reassurance they will find it in an article contributed by M. Léon Thomas to *La Nature*.

M. Thomas undertook some experiments in Belgium for the satisfaction of the Belgian Government Explosives Committee, and at the instance of the three Belgian dynamite manufactories. They were made at Bewerloo, not far from Antwerp, and were curious and interesting.

To show the effects of the explosive fifty fixed or movable screens, and two small wooden bungalows with windows, were arranged round the firing point at distances varying from 16 feet to 5 miles. The dynamite exploded was of the regulation kind, and was fired off in four successive charges of 55 pounds, 100 pounds, 200 pounds, and finally of 1 ton.

The distances at which the destructive effects were felt were surprisingly small. The shock of the 25-pound charge was felt only as far as 58 feet, and even the ton of dynamite made its explosion felt at a less distance than $\frac{1}{4}$ mile.

But there was an unexpected subsidiary effect. Beyond the distances at which the direct effects of the explosion were felt was a neutral zone; and beyond that again there was a region of return shock. In the bungalows placed beyond the neutral zone the windows were broken, but the panes had all fallen outwards, as if by suction; this effect was more or less perceptible up to distances of $2\frac{1}{2}$ miles. In this zone of return shock solid constructions were not hurt.

From the experiments carried out it may be deducted that the radius of the effect of a charge of dynamite varies as the square root of the charge.

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THE REORGANISATION OF THE EAST SIBERIAN ENGINEERS.

From the RAZVIEDCHIK.

An experience of over 10 months in the present Russo-Japanese War has brought to light certain discrepancies in the organisation of our Sapper Battalions, and especially in that of the Six-Company formation of the East Siberian Battalions.

According to the establishment of the latter, there are 4 Sapper, 1 Pontoon and 1 Telegraph Companies in each, as well as 2 light 70-ft. bridging equipments. Consequently the general organisation of these Battalions appears extraordinarily cumbersome, with an enormous quantity of varied and most complicated equipment; to say nothing of the almost encyclopædic knowledge with regard to engineer, pontoon and telegraphic gear entailed on the part of the Battalion Staff.

Moreover, this variety and wealth of equipment, as well as the number of the *personnel* of the Battalions (over 2,000 rank and file*), necessitate much detailed correspondence on the part of the already over-taxed orderly-room staff in connection with demands for engineer equipment and with the no less intricate returns for clothing, provisions and forage.

The work is still further complicated by the addition to certain East Siberian Sapper Battalions of supernumerary Mounted Sapper Sections and Signalling Stations;† and, although only temporarily detailed from Battalions, they have to be accounted for in its orderly-room returns.

In addition to returns for supplies and equipment the work of the orderly room and of the battalion Quarter Master is further increased by the large number of horses on the strength, which are kept up on a war footing even in peace time. These amount to no fewer than 550; not counting the 2 light bridging parks (42), the mounted sapper section (42), the 4 supernumerary signalling stations (20), division of the field engineer park (65), pontoon company (62), and the extra horses needed when the transport of 2 Sapper companies is changed from wagon to pack transport (52). Altogether the total number of horses in a six-company battalion reaches the respectable figure of 833—almost as much as a whole Cossack regiment!

All this cumbersome and complicated mechanism, created little by little and necessitated from time to time by the exigencies of the war, has now evidently reached the apogee of its development; and strains to the utmost the capabilities of the Battalion Staff. Consequently it sometimes

* This appears to refer to peace strength of combatants in the 6 battalions.
† These "stations" include *matériel* as well as the *personnel*.

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occurs that their duties are not carried out with all the exactness and promptitude that one could desire.

It is suggested therefore that under these circumstances the organisation of the East Siberian Engineers should be remodelled somewhat on the following lines :—

1. The telegraph and pontoon companies to be detached from the three Six-Company battalions (1st, 2nd and 3rd), and the remaining 4 companies in each to include equipment for 2 micro-telephone stations with 8 verst cable per company.

2. The telegraph company to be detached from each of the Three-Company battalions (4th, 5th and 6th), and micro-telephone stations added as in (1).

3. Two Three-Company independent Battalions to be formed from the six telegraph companies above ; and

4. One 2nd East Siberian pontoon battalion* from the pontoon companies of the 1st and 2nd East Siberian Battalions ; and finally

5. One East Siberian depôt pontoon battalion* from the pontoon company of the 3rd East Siberian Battalion, with reserve equipment for a pontoon half park.

In this manner it would be possible to form 2 Brigades, viz. :—

1st Brigade.—1st, 2nd and 3rd E. Sib. Sapper Battalions.
1st E. Sib. Pontoon Battalion.
1st ,, Telegraph ,,
E. Sib. Reserve Sapper ,,

2nd Brigade.—4th, 5th and 6th E. Sib. Sapper Battalions.
2nd E. Sib. Pontoon Battalion.
2nd ,, Telegraph ,,
Depôt Pontoon ,,

The light bridging equipments, on account of their unsuitability for East Siberia and Manchuria would be done away with. (It is stated that a certain general of high rank on the active list once said that these parks would be an excellent institution if one could only carry about a 70-foot stream as well).

* By a recent Army Order the two battalions were to be formed from the pontoon companies of the present 1st, 2nd and 3rd battalions and one company of the 5th battalion, the last named to be replaced by a new sapper company.

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REVIEWS.

DETAILED HISTORY OF THE RAILWAYS IN THE SOUTH AFRICAN WAR, 1899—1902.

(2 vols. fscap. £2 2s. Royal Engineers Institute, Chatham).

After the War was over the various reports from South Africa on the Railway operations were abridged and re-arranged at the War Office to form a connected *History of the Railways during the War in South Africa*, 1899—1902. This compilation was divided into 4 volumes, each accompanied by its own illustrations; the first consisted of an original "General Report" by Lieut.-Col. Sir E. P. C. Girouard, K.C.M.G., R.E., Director of Railways; the remainder comprised abstracts of numerous other reports, concerning the Cape Government, Natal Government and Imperial Military Railways and also sundry special organisations which, though strictly speaking extraneous to Railway working, had been inaugurated and administered by Railway Officers under the control of the Director.

The *History* was completed in November, 1902, submitted for official publication, and accepted; but considerations of the expense involved subsequently caused the Lords Commissioners of the Treasury to sanction the printing of the 1st volume only, and this was issued at the end of 1903 under the title given in the preceding paragraph.

The decision not to print the remaining 3 volumes came, in July, 1903, to the knowledge of the Royal Engineers Institute; and its Committee resolved, in October, 1903, to complete the publication themselves, rather than allow such a valuable record of the largest Railway operations ever undertaken by a British Army in the Field to be entirely lost to posterity. These 3 last portions of the original compilation are now issued under the title that heads this notice, and consist of 2 volumes only, viz.:— I. Letterpress, II. Illustrations.

The letterpress volume deals in detail with the separate branches of Railway working on the various lines. Parts I. and II. deal respectively with the railways in the British Colonies of the Cape and Natal. In addition to general descriptions of the railways themselves, and of their normal technical organisation, will be found much valuable matter regarding the measures taken to work them under the stress of invasion and war.

The reader's special attention is directed to Chapter II., Part I., wherein are discussed at some length the questions of the establishment of a Military Controlling Staff and the relations which should exist between it

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and the Technical Staff of a railway in friendly country. The absolute necessity for arriving at a clear understanding on the subject of a Military Controlling Staff renders it incumbent on officers of the General Staff to educate themselves in this matter, and to widen their views by a study of the principles enunciated by other European Armies. Such extended studies, supplemented by the experiences of the South African War, will enable them to see clearly to what extent Military Control is necessary and at what point it becomes harmful.

The Appendices to Chapter III., Part I., will repay examination; they show what can be done with limited rolling-stock in the way of large troop movements on making a strategic change of front. The Appendices to Chapter VI., Part II., furnish further examples from the work of the Natal railways during the War.

Part III. deals with the organisation and work of the Railway Pioneer Regiment, a unit which was specially raised in South Africa to assist in dealing with the immense amount of repairs rendered necessary on railway lines through the wholesale destruction carried out by the Boers in their retreat before the British Army in the Orange Free State.

Part IV. contains a full account of the Imperial Military Railways, a title given to the enemy's lines as they were successively captured. It divides itself broadly into the history of the Reconstruction, Management and Working of the Railways in the Orange River and Transvaal Colonies.

In Chapter I. the necessity of a Military Controlling Staff is further emphasised, reference being made also to the modifications found necessary in an enemy's territory. The Appendices to this Chapter all furnish useful information regarding the various railway problems which arose in the conquered territories. Appendices A, B, and N are perhaps the most important, containing as they do the instructions issued for the guidance of the Army generally and of Railway Staff Officers in particular; the relation of these latter to the Director of Railways was much discussed, but after considerable experience it was finally agreed that they should be placed under the orders of the Director. Appendices E, G, and H furnish further examples of large troop movements undertaken for strategic purposes.

Chapter II. contains an account of the Engineering work,—temporary, semi-permanent and permanent,—which fell to the lot of the Works Department, and is of great interest to technical Engineer Officers; the photographs and drawings will repay careful study. The detailed organisation and equipment of Construction Trains is dealt with, and should prove useful to officers in charge of similar trains in future campaigns; the necessity for employing Military officers and men on these trains (when time rather than economy in construction is the prime factor) is very clearly brought out. This Chapter further shows how advantage was taken of the presence of experienced civilian railway engineers when the enemy's lines had fallen into our hands.

The difficulties experienced by the various working departments of the Imperial Military Railways (viz.:—Traffic, Locomotive, Telegraph, Stores and Accounts) are set forth in Chapters III. to VII. These possess an

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interest which is primarily technical, but which will also furnish much food for thought to those who are anxious to gain an insight into the practical working of a great system of Railways on which an Army in the Field is dependent for all its supplies.

Chapter VIII. deals with the Railway Police; and Chapters IX. and X. with the Railway Staff Depôt and the Railway Employment Office, special organisations to meet somewhat peculiar circumstances, the former for the administration of troops employed on the Railways and the latter for the enrolment of Europeans for work on the same.

Chapter XI. is a report on Laurenço Marques, Delagoa Bay, and the arrangements made to work harmoniously with the authorities of Portugese East Africa.

Part V. contains a most interesting account of the organisation, equipment and use of Armoured Trains.

Part VI. treats of the Army Labour Depôts, another special organisation, established by the Director of Railways to meet the demands of the Army at large for Native labour.

Volume II. contains reproductions of 61 full-plate photographs and also 93 drawings, many of considerable size, dealing mostly with bridge work and armoured trains. Each volume has for frontispiece a coloured map of the theatre of war, and Volume I. also includes numerous diagrams illustrating the text.

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THE DESTRUCTION OF MOSQUITOS.

BEING AN ACCOUNT OF THE DRAINAGE AND OTHER WORKS CARRIED OUT WITH THIS OBJECT DURING 1902 AND 1903 AT ST. LUCIA, WEST INDIES.

By MAJOR W. M. HODDER, R.E.—(Royal Engineers Institute. 2s. 6d.).

The author explains in the preface that these notes were compiled as the result of a suggestion by the War Office that an account of the various works carried out at St. Lucia, during 1902–1903, might prove useful to officers of the corps and others placed in similar circumstances elsewhere. From the first the object aimed at was the destruction of mosquitos, and in carrying out this destruction the drainage of swamps was by no means the only plan adopted. There is a chapter on the outbreaks of yellow and malarial fevers at St. Lucia, followed by one describing how yellow fever was stamped out at Havana. The author, in referring to the habits of mosquitos, says that those who wish to make themselves acquainted with mosquitos and their habits must consult technical books, but for the purpose in hand he gives his own personal observations on the ways and manners of these insects, "looking on them as vermin, so to speak—pestiferous creatures" to be hunted and destroyed by every possible means which can be devised. The Royal Army Medical Corps and Royal Engineers appear to have carried out a large amount of drainage, clearing, and reclamation works since the renewed occupation of the island, but they were insufficient to check malaria to any great extent. The author, referring to these former works, admits there was gained through them an immense advantage by those who were commissioned to continue the work, through knowing why the various works were required. Whereas those who had initiated them had much groping in the dark. All that was known was that the swamps were "bad," but the reason had not then been discovered. Dealing with the precautions to be observed before and during the building of barracks in malarious countries, the author says careful consideration of the site of the proposed barracks is of vital importance, but before all it is the paramount duty of the Government to ponder well whether a malarious country is worth occupying by troops at all. The author explains how it was the Americans were so successful in carrying out the sanitary system which was inaugurated in Cuba. There are two photographs of Cocoanut Swamp, Vigie, one showing the arterial drain in course of construction in May, 1902, and the other the drain completed, April, 1904. The work is a valuable contribution to sanitary science.—(*Broad Arrow*).

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In an illustrated pamphlet on "The Destruction of Mosquitos" Major W. M. Hodder, R.E., gives an account of the drainage and other works carried out during 1902 and 1903 at St. Lucia, West Indies, for the prevention of malarial sickness. Reference is made to the experiments made in Havana, and after studying the statistics Major Hodder states that he "cannot imagine any way in which yellow-fever can be communicated other than by mosquitos." It is admitted that the anopheles species of mosquito conveys malaria to human beings, and from the figures given it will be seen that the precautions taken to prevent malaria were in this instance effective. This ably-written treatise should be studied by those who really wish to understand the subject.—(*Morning Post*).

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THE CROSSBOW.

ITS CONSTRUCTION, HISTORY AND MANAGEMENT, WITH A TREATISE ON THE BALISTA AND CATAPULT OF THE ANTIENTS.

By SIR RALPH PAYNE-GALLWEY, BT.—(12½" × 9½". £3 3s. Longmans, Green & Co., 1903).

This is one of those monumental works which, owing to the very wealth of its statistics, illustrations and research, is bound to form the standard work for all time on the antient and mediæval weapons it describes so well. As an *Edition de luxe* for the library of the sporting *savant*, the antiquary or the military engineer, no work prepared with such colossal labour has, within our knowledge, been brought before the public in recent years.

This complete masterpiece can be opened at any page, affording restful occupation to the reader, who, perhaps well-nigh nauseated unto death by the wasteful stress and fret of modern existence, is enabled thereby to penetrate into an atmosphere permeated with the grotesque glamour of the middle ages and to live for a little while only in the past—that dim mysterious past of over 2,115 years ago. It is impossible to open its pages without discovering some point of interest, historical, mechanical or biographical. The greatest credit is due to that well-known sportsman, Sir R. Payne-Gallwey, for its production; there is nothing like it in existence; the author could not have a better memorial than this outcome of his taste, discrimination and learning.

The weapons selected for description are the Balista and Catapult of the antients and the Crossbow of mediæval times, with its correlatives the Longbow, the Shortbow and, finally, the Hand-Gun, all of which are most admirably dealt with. Seventy pages of accurately detailed matter are devoted to the great projectile weapons, and 250 pages are taken up with the mediæval and modern, military and sporting history, construction and management of the crossbow and its variations.

The work is illustrated by 220 engravings, many of which are woodcuts from pictures by celebrated masters, illustrative of scenes of the chase, sieges of fortified towns in the French and Italian style, and so forth. Some of these, showing the minutest details of mechanism of the siege engines, are by the famous painter, Leonardo da Vinci, distinguished alike as an Italian painter and as an inventor and writer on mechanics. Accurate diagrams are given of the various weapons and their parts, some of which have been reconstructed by the author for experimental purposes.

To treat adequately of the vast storehouse of information included in these pages is a task far beyond the scope of a review; all that can be

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attempted is to indicate the nature of the salient points, which render the facts concerning these siege engines and the crossbow so instructive to the military engineer. These details, when correctly interpreted, shed great light on the social and military life of the antient European nations as they then existed, enabling us to trace out the gradual development of the old-time tactics of the battlefield, when co-ordinated to the weapons which were then in use.

This historic *chef d'œuvre* includes the period dating from B.C. 214—A.D. 1480; from the great times of the Roman power until the period of the Renaissance, marking the termination of the Tudor dynasty at a time when archery was giving way to gunpowder, and the love of money and luxury had so degenerated the taste of the English people for arms that special statutes enacting compulsory training in archery had to be passed.

Commencing with the antient siege engines, the Balista and the Catapult, the author gives his authorities, which include such varied sources as:—Athenæus, B.C. 212; Polybius, B.C. 200; The Bible, Chronicles and Ezekiel; Julius Cæsar, B.C. 48; Tacitus, A.D. 61; Vitruvius, B.C. 180; Plutarch, A.D. 66; Vegetius, A.D. 380; Froissart, A.D. 1400; Grose, A.D. 1780; Viollet-le-Duc, A.D. 1861; Napoleon III., A.D. 1859.

The Balista and Catapult were nearly always used at the antient sieges up to the 14th century, the Balista discharging great arrows, whilst the Catapult cast forth heavy pieces of rock and balls of stone. The Catapult in Roman times was christened the Onager, or Wild Ass, and in mediæval times has also been called a Mangonel. These antient siege engines not infrequently had their huge frameworks put together on the spot by cutting down available trees, their movable parts and fittings being transportable with the field army in carts drawn by oxen.

Light Balista, or field artillery Balista, referred to as Carro-Balista, which were mounted on wheels, were also used. These discharged their missiles over the head of the well-trained mule, who occupied the shafts of the wheelcart. Eleven soldiers formed the gun detachment. Several of these field weapons appear on the Trajan column erected in Rome, A.D. 105—113, to commemorate the victories of Trajan over the Dacians.

In the organization of the Roman army every cohort had one Catapult, every century one Carro-Balista; thus every legion of 6,100 men was provided with ten Catapults and sixty light Balista, or in modern parlance ten machiné guns per battalion and six 5-inch howitzers per brigade.

The motive power for discharging the projectiles was obtained by twisting skeins of cord, acting as a spring which actuated a throwing lever.

Catapults taken from the enemy were esteemed in high honour as prizes, as is recorded at the siege of Carthage, B.C. 146, at Paris, A.D. 885, and at Acre, A.D. 1191. These antient siege engines were likewise wont to be treated with great respect by the soldiery, in direct proportion to the power and accuracy displayed by the weapon. A proper pride was taken in the individual engine, those which were popular, or the reverse, being christened the Bull Slinger, Queen, Lady, Wild Cat, Onager, just as in later times we have Brown Bess, Long Tom, Woolwich Infant and,

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in the times of our latest civil wars, the Sow and the Boar, as employed at the siege of Gloucester, A.D. 1643.

Edward I. of England, a great believer in siege engines, constructed such a weapon for the attack of Stirling Castle, A.D. 1303, delaying the proffered surrender of the town until an opportunity of experimenting on its defences with his pet engine, the War-Wolf, had presented itself.

The origin of the Balista and Catapult engines is said to rest with Archimedes, who, when besieged in Syracuse 214—212 B.C., in the intervals of his more abstruse studies in geometry and mathematics, had carried out trials in the projection of heavy weights by means of levers. Plutarch, writing in A.D. 65, alludes to Archimedes as the informing soul of the siege, all the others, citizens and military men, being mere puppets, the missiles from his engines, arrows for short range and huge rocks for long range, plying the attacking and retreating Romans from all quarters.

From experiments made with reconstructed siege engines by Sir R. Payne-Gallwey, we gather that a range of between 300 and 400 yards with a 2 to 3-cwt. stone ball is obtainable, agreeing with the range laid down by Josephus, A.D. 80, as that of the Balista at the siege of Jerusalem.

Another engine introduced in the 12th century is minutely described by the author, and that is the Trebuchet. This weapon depended for its motive power on the falling of a heavy weight or counterpoise at the further end of a lever arm, on the principle of the seesaw. By this means, at the siege of Cyprus, A.D. 1373, stones weighing as much as 12 cwt. were cast forth. A sling was sometimes attached to the other end of the lever arm, increasing the range of the throw. At the siege of Carolstein, A.D. 1422, dead horses, the bodies of men, with the additional increment of 2,000 cartloads of manure, were ejected into the town by means of the Trebuchet, with a view to creating a pestilence.

On one occasion an emissary with peace proposals was seized and shot back again into the besieged town of Auberoche, from which place he had just sallied forth with mutually favourable terms of agreement.

As an instance of conservatism it is instructive to note that De Foulard, a French expert on tactics, writing as late as A.D. 1727, urges the advantages of the catapult over the mortars and swivel guns of that period; he states that the chief disadvantage of the cannon is the noise it makes. He reiterates the disadvantages of the hand-gun when compared with the crossbow, arguing that, if it were not for the bayonet at the end of the gun, and to the gun being of use in places where there is only a restricted area for attack and defence, the deadliness of aim of the crossbow would more than counterbalance the utility of the gun.

Over sixteen centuries of catapults, and many more than sixteen centuries of bows and arrows, and no man since Archimedes, with his heaven-born genius for mechanics, to originate a new idea capable of overcoming the prejudice of custom until the discovery of gunpowder as a motive power.

Even the Trebuchet, a new engine introduced after the lapse of fourteen centuries, was atavistic in its tendencies, depending simply on gravity, without even the spring of the Roman Balista. The progress of

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mechanical military engineering had been strangely slow; and why not, it may be asked, in the presence of powerful sacerdotal bodies, limiting the extent to which it shall be lawful for the human mind to prosecute its natural enquiries. The engines of the Romans embraced, in addition to the rope spring, cogwheels and pawl, sliphook and windlass; those of the 15th century, as depicted by da Vinci, showing a small advance only in mechanism, comprised the endless screw, spring buffers and cutting edge at end of trail to check recoil, cords and pulleys, coupled wheels and connecting rods, rack and pinion, spanner, trigger, releasing catch and screw nut.

Although these antient siege engines gradually disappeared from civilized warfare when cannon came to the front, catapults were still used in barbaric armies, by the Arabs for instance, long after they were discarded in Europe. Their final appearance before a European public was at the siege of Gibraltar, A.D. 1779, being employed for evicting projectiles over precipices, by General Elliott, R.E., afterwards Lord Heathfield.

We can now deal with mediæval small-arm weapons, the decisive arms at many a hard-fought fight in the good old days of yore, the fateful arbitrators by which the destinies of nations, our own in particular, have been fashioned and decreed.

Amongst the antient siege engines described in this book the Roman Balista was included. In using this weapon the Romans were gradually paving the way for the introduction of the crossbow of the 12th century and its improved developments, of which the Balista was the prototype. The evolution of the crossbow, and kindred weapons took place gradually.

Vegetius, a Roman writer on the art of war, whose words are full of wisdom and philosophy, and very far from being mere exercises in archæological curiosity alludes, in the year A.D. 385, to the crossbow as being a manual weapon assigned to light-armed troops, some of whom, doubtless, would be allotted to the grand old garrison army, composed of many men of from 20 to 25 years' service, which occupied the Roman castrums in this country for the first four centuries of the Christian era, each legion of 6,100 men, besides engineers and artillery, having 300 mounted scouts and cavalry attached.

From the 5th to the 10th century there is no record as to whether the crossbow was in common use or not.

In the 10th century we find the crossbow well established, for it is recorded by the monk Richer, in his *Historia*, that at the siege of Verdun the arrows from the crossbow were careering about in the air so thickly that they seemed to be coming down from heaven like falling rain and again coming out of the earth like rising mist.

At the battle of Hastings, A.D. 1066, it has been suggested as one of the reasons for defeat that the irregularly armed jovial English Militia, who fought on foot, armed with shield and javelin, battle-axe and mace, were at a disadvantage when compared with the chivalry of Normandy, mounted on horseback, many of whom were armed with crossbows, prepared for an immediate assault on their foes, *arcubus tensis*, *i.e.*, "stretched bowstrings," being the order of the day. William II. was

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accidentally (so 'tis said) killed in 1100, when out deer hunting, by a bolt shot from the crossbow of Sir Walter Tyrrel. William II., Henry I., Stephen and Henry II. all employed foreign mercenaries as crossbowmen in their armies as experts and instructors.

Richard I., again, in A.D. 1189, in spite of a papal decree prohibiting it, re-introduced the crossbow; and so skilful in its use was he that he killed quite a few men by his own hand, eventually falling a victim himself to the very same weapon at the hands of others.

At Lincoln, in A.D. 1217, the relieving force consisted of 400 knights, a number of foot sergeants and 317 crossbowmen. At Taillebourg, A.D. 1242, Henry III. was defeated by Louis IX., who had 700 crossbowmen in his army; but in 1272 the longbow came to the front in England, the crossbow declining as a military weapon. At Agincourt, in 1415, out of 8,000 men only 38 were crossbowmen; whereas at Crécy, in 1346, 15,000 were in the front rank of the French army.

In the 13th and 14th and first half of the 15th century crossbows in the Continental armies were still adhered to for the *corps d'élite*, who were naturally placed in the forefront of the battle line. In Spain, in the 14th century, the crossbow had become such a costly weapon that only those dons who could provide themselves with crossbows at their own expense were granted the rank of a knight. The post of "Master of the Crossbowmen" of France, Italy and Spain was one of high dignity.

Mounted crossbowmen, all knights or of superior denomination, were specially employed on the Continent in the 14th and first half of the 15th century; besides being provided with two horses apiece, and supplied on the line of march with carts in which to carry their crossbows, they had the additional privilege of decorating their horses with variegated bouquets of flowers, fore and aft front and crupper. For head-dress a large picture hat was worn, surmounted by a canopy of flamboyant plumes, a short arrow, 9½ inches from tip of arrow to tip of the nose, being jauntily set in a side loop. For the protection of their ankle joints when mounted four tiers of ruffled flounces were worn. The *tout ensemble* of these mounted crossbowmen of Spain on their gaily caparisoned steeds was in itself sufficient to terrify the hearts of the most ardent foe.

Crossbowmen were employed in limited numbers on the Continent only till 1515, except in France, where they were popular till 1520; hand-guns and crossbows with steel bows had begun to supersede the ordinary crossbow abroad between the years 1460 and 1470.

The band of adventurous Spaniards, who accompanied Pizarro to explore Peru in 1524, were all well-to-do crossbowmen; but in his conquest of Peru in 1532–33 only twelve crossbowmen were present amongst his followers. Cortes, at the siege of Mexico in 1521, used only one company of crossbowmen.

We find that those Continental nations who, about the year 1522, discarded crossbows for open warfare still used them in sieges.

In 1572 the crossbow was practically extinct in warfare, and the English longbow was also rapidly falling into disuse.

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The last occasion crossbows were used against a British army was at Taku Forts in 1860, many of the Chinese being armed with this weapon. But for sporting purposes the crossbow was used for killing deer in France up to the year 1621, and also in England. In that year a keeper of Bramshill Park, Hants, was accidentally slain by Archbishop Abbott, of Canterbury, by the bolt from the crossbow of this prelate, who had unfortunately aimed at a stag.

Early in the 16th century the double-stringed crossbow was introduced, and became very popular with sportsmen, ladies, foresters and keepers as a means of obtaining game-birds, pigeons, hares and rabbits. Towards the end of the 17th century target practice with crossbows was much indulged in as an amusement. In 1760 the stonebow was improved, and by 1810 it was fashionable, being popularly known as the bullet crossbow.

Foreign ships of war still used the crossbow for defence after its decline in 1525 as a weapon on shore. Coleridge's antient mariner in shooting the albatross with a crossbow was not performing an impossible feat-at-arms, for our author has himself shot a bolt with a 15th century crossbow over and across the Menai Straits, a width of more than 400 yards.

Shakespeare alludes to the accuracy of the crossbow in "Twelfth Night," when Sir Toby exclaims: "O! for a stonebow! to hit him in the eye!"

The crossbow is, even at the present day, used for target shooting in Belgium, and competitions at a target with a small bolt-shooting crossbow have been common as a recreation in North Germany and Belgium for some centuries.

Part I. of Sir Ralph Payne-Gallwey's book deals with the history; Parts II. and III., of the construction and management of crossbows, mediæval and modern. In Part I. are comparative notes as to the relationship between the crossbow, the longbow, the shortbow, and the hand-gun.

The shortbow appears to have been the primitive weapon. At Marathon, B.C. 490, we even read of the black archers of Ethiopia fighting in the hybrid and motley gang comprising the Persian army. The early Saxons were wont to use the shortbow, one of which is depicted in the Bayeux Tapestry, illustrative of the Norman Conquest, but no longbows are shown. However, at the time the battle of Hastings was fought the chief weapons of the Saxons were the spear and the battle-axe. The longbow, a most powerful weapon, appeared in England shortly after 1200, and held its own till about 1370, when the improved crossbow, with thick steel bow and windlass, was introduced as an adjunct.

The shortbow was then more often the arm of mounted men owing to its portability, and could be slung on the back of the soldier with cord over the breast like a short rifle. Owing to the fact that the longbow, with string drawn back to the right ear instead of only to the breast, far outranged the shortbow, it became the popular weapon for infantry, and was largely used by Edward I. about 1272—1300; but after the year 1340 the English soldiers carried longbows only, these superseding shortbows and the primitive crossbow.

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The successes at Falkirk in 1298, at Crécy 1346, Poitiers 1356, and, finally, at Agincourt 1415, secured the predominance of the longbow for British warfare. The crossbow still lingered on as an easily manipulated weapon for deer slaying, and also at the butts; so much so that, with the exception of nobles and persons of wealth, even the possession of a crossbow had to be forbidden by law in England, owing to the danger that skill in the longbow might be wanting in a national emergency. This was in the year 1508 and again in 1534, during the reigns of Henry VII. and Henry VIII. It was also forbidden to shoot herons with a crossbow, heron-hawking being the favourite sport of royal and noble falconers.

It was about this time that our Continental enemies encouraged the development of the hand-gun, which weapon would place their soldiers, young or old, on an equality with the tall and strong English archers, and which, unlike the longbow, the gradual disappearance of which they hailed with delight, required no great strength to manipulate.

The English kings and troop commanders, however, were loth to believe that any weapon ever invented, or likely to be, could compete with their cherished longbow, by which so many truly glorious victories had been achieved in the past. It was not without a long and persistent struggle with gunpowder, as applied to the hand-gun, that the longbow was finally discarded by the English people about the year 1590, and it died hard, its re-introduction being advocated so late as 1798 in conjunction with the pike. So curiously does English history repeat itself from the days of crossbows and longbows up to more modern times.

Even when it was realized in 1580 that the longbow was being hopelessly beaten by the hand-gun several statutes were passed to save it from extinction as our national and well-tried weapon, its historic reputation being so great that many pamphlets were issued during the 18th century advocating its re-introduction as the greatest of all military weapons. The hand-gun did not, by any means, jump into popularity with rapidity, the first people to use it being the Florentines and Hussites in Bohemia, 1436. After Crécy the French tried the longbow, but after proclaiming that English archery was a very peculiar gift of God, they gave it up, reverting to their favourite weapon, the crossbow.

The first hand-gun was in reality a miniature cannon with a metal tube ½ inch in diameter and a touch hole for priming powder, lit by a burning fuse; a straight piece of wood supported the tube, a handle being fixed to the breech end to hold and direct it. By and by a straight stock was fixed; sighting over the thumb, as in the crossbow, was retained till 1500, when an enlarged butt-end for the shoulder appears. The next variety of the hand-gun was the culverin, with barrels resting on a forked stick with matchlock and flash pan. In 1510 the matchlock arquebus, with trigger and automatic ignition, came in, to be followed by the wheel-lock in 1560, the wheel grinding against a composition of pyrites in the jaws of a hammer kept down by a spring. This in turn gave way to the flintlock produced in Spain about 1625, flint being substituted for the pyrite; the hammer was now cocked and released every time the gun was discharged, the springs of the lock

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acting as in a modern gun. Flintlocks were introduced in England in 1690—1700, and with slight modifications were carried by our soldiers till 1840.

It took some 200 years to push the hand-gun, with lock, stock and barrel complete, into the British army, so disinclined was the nation, whose prowess in the longbow had been termed by their enemies "A peculiar gift of God," to take up any innovation in weapons. Although the Chinese had from time immemorial used a double-barreled repeating crossbow, discharging as many as two dozen arrows in 15 seconds by merely working a lever to and fro, the date of its origin being beyond conjecture, we do not hear of its ever having been adopted, even in principle, by European nations till some 2,000 years later, when its detachable magazine became harmonized in principle with the European single-barrel rifle about the year 1880 as an experiment.

Nor does there appear to have been any particular reason for change as long as the European nations were content, in mediæval to later times, to kill each other with out-of-date weapons, always provided that no man should steal a march on his neighbour by adopting a secret arm, the details of which were unknown to others.

All the weapons in early use in Europe appear to have been common property; indeed, Richard I., who was slain by a crossbow near Limoges in 1199, is said to have introduced the weapon into France. Some nations preferred the crossbow, others the longbow, as more suited to the national temperament; but then came a time when, owing to the discovery of gunpowder, some comparatively insignificant people thought it would be advantageous to make up for their deficiencies in other respects by using their brains to outwit their more powerful enemies, experimenting with new arms; and by degrees, in the fulness of time, their more ponderous neighbours followed suit.

(To be continued).

O. E. RUCK

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NOTICES OF MAGAZINES.

BULLETIN OF THE INTERNATIONAL RAILWAY CONGRESS.

December, 1904.

This number, which consists of something like 400 pages, contains so much reading matter that it is hardly possible to notice the contents in detail. The principal papers are to be presented at the next meeting of the Congress at Washington next May. The following are perhaps the most interesting from an operation point of view:—

SUBURBAN TRAFFIC.—By H. G. Drury, Supt., G.E.R.—In the great cities, and more especially in London, while the attraction of life in a centre of population continues steadily to draw people from the country to the city, there is a continuous migration of people from the central to the suburban districts. The vast crowds, who throng the city streets during the day, go into the suburbs to sleep; and the position to be met is that practically the whole of the working population has to be brought into town and taken back again daily.

The pressure of traffic is thus concentrated between certain close limits of time; and since also legislation imposes a severe obligation on companies with regard to running workmen's trains, the traffic is not recognised as remunerative. In fact, if it pays working expenses, it can hardly be expected now to return interest on capital.

As to the handling of the traffic, the determining conditions are:—

(1). The frequency with which trains can be run from a given centre.
(2). The greatest number of passengers per trip which a train can carry.

It is fairly obvious that the greatest train capacity which a line can attain is accomplished when all trains on one pair of metals run at the same speed, assuming that terminal facilities are adequate to avoid delay in turning and the block which might be entailed thereby.

It follows that, to attain the maximum capacity, trains which stop at all stations and those which, serving further off districts, stop at certain stations only must have separate roads.

The average overall speed of suburban trains attained on the G.E.R. is 19·5 miles per hour.

The enlarged carriage sets provided can seat 808 passengers in 15 coaches, and by lengthening platforms it is apparently intended to increase trains to 17 coaches.

Mr. Drury considers that, although electricity may be adapted to working short local traffic of a continuous character in well-populated districts—

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trains conveying say 400 each—it has not so far been shewn that it would answer for long and heavy-laden trains and so great a volume of traffic as is experienced on suburban lines in this country.

He thinks that the following are main desiderata :—

(1). Engines to start quickly and attain speed rapidly.
(2). Trains to be short buffered and of large capacity.
(3). Trains to be fitted throughout with automatic continuous brake.
(4). Stations to have straight platforms, so that Guard can see along train.
(5). Line through station to be level.
(6). Block sections to be about half a mile long.
(7). Termini to have loops, so as to obviate trains entering and leaving having to cross one another's path.
(It will be recollected that this expedient has been successfully adopted at the new Boston terminal.)

LOCOMOTIVES OF GREAT POWER.—By M. E. Sauvage, of the Chemin de Fer de l'Ouest.—M. Sauvage reviews exhaustively the most recent developments in locomotive design, but comes to the conclusion that it is vain to expect finality. It may be tempting to keep for a long time to standard types, and so simplify maintenance; but progress, which does not stop, hardly allows such types to be reached with satisfaction.

He considers the most important determining factor is the permissible wheel load, remarking that as high a figure as 10 tons has been allowed on some English railways. The danger of these heavy loads is that of fatigue in the rails where the oscillations of load are large.

Wheel diameters seem disinclined to increase beyond 6′ 6″; with very high-speed engines, decrease of size introduces the difficulty of excessive wire-drawing of steam.

He thinks that the use of widened fireboxes will become more extended; but the problem of stoking has not been satisfactorily met up to the present.

M. Sauvage is a decided advocate of the compound system, in the form of a four-cylinder engine with separated valve gears for each group, and cranks placed at 180° so as to facilitate balancing—in fact the De Glehn type.

The only type of very powerful locomotive, with its whole weight adhesive and arranged to run round sharp curves, which is largely used is the Mallet design. Some such are apparently in use on the Siberian Railway (two sets of six-coupled wheels).

The number also contains a report on the cheap working of branch lines, by steam carriages and so forth, bringing out the point, incidentally, that branch lines afford a place where the rolling stock no longer up to main line standard can be used up; also a general comparative review of the working of French, German and American Railways, this latter shews that the average capital cost per mile of railways in England is nearly three times that in Germany.

C. E. VICKERS.

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REVUE D'HISTOIRE.

January, 1905.

THE CAMPAIGN OF 1794.—*Army of the North.*—This section is devoted to military ballooning, a subject which was taken up warmly by some of the scientific men who advised the Committee of Public Safety. A factory was established at Meudon; a balloon company was formed; a code of signals was drawn up for use at night; reconnoitring from a captive balloon was practised at Maubenge as part of the operations of defence; and at length, on June 26th, it was employed on the battlefield of Fleurus. The balloon used was spherical, 27 feet in diameter, and rose to a height of 1,200 feet. General Morlot went up in it, and sent reports to the French commander-in-chief, which Morlot believed were very useful to him. Jourdan, however, afterwards said that they had been misleading, and that beyond astonishing the enemy at their first appearance, he had never found balloons of any use.

SIDI-BRAHIM.—Extracts are given from a forthcoming work which deals with this episode of Algerian warfare, the disaster to Lieut.-Colonel Montagnac's column in September, 1845. The account here given of it is very carefully compiled, and differs in some respects from the graphic sketch by the Duc d'Aumale in *Les Zouaves et les Chasseurs à Pied.*

THE WAR OF 1870-1871.—*The 18th of August in Lorraine.*—The description of the battle of Gravelotte, which (including appendices) has extended to nearly 1,200 pages, is at length completed. The battle cost the French 13,218 officers and men, and the Germans 20,160. In the evening Bazaine telegraphed to the Emperor:—"I have just come back from the plateau. The attack has been very brisk. The fire is now (7 o'clock) dying away. Our troops have held their ground. One regiment, the Sixtieth, has suffered heavily while defending the farm of St. Hubert." This misleading report seems to have been mainly due to ignorance of the real situation. His great preoccupation throughout the day had been lest the Germans should work round his left, down the valley of the Moselle, and cut him off from Metz. His intervention in the battle was confined to superintendence of the fire of some guns on Mont Saint-Quentin, and sending off two batteries with a score of ammunition wagons to the Sixth Corps. The orders for the retirement of the French corps to positions under the guns of Metz seem to have been drawn up on the morning of the 18th, and issued at night without modification.

E. M. LLOYD.

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RECENT PUBLICATIONS.

The King's Regulations and Orders for the Army. 1904. (Provisional Edition). (1s. 6d. Wyman & Sons).

A Short Guide to the Various Ways of obtaining a Commission in His Majesty's Regular Forces, together with some Information as to Pay, Allowances, Choice of Regiment, Outfit, etc., and Directions as to the Regulations which should be consulted. War Office. (4d. Wyman & Sons).

Regulations for the Equipment of the Army (Auxiliary Forces), Part 2, Sect. XVIII., Volunteers. (6d. Wyman & Sons).

Lhasa and its Mysteries (an Account of the British Mission to Lhasa, 1903–04), by Lieut.-Colonel L. A. Waddell, C.B., C.I.E. (8½ × 5½. 21s. John Murray).

Lhasa, by Perceval Landon. 2 vols. (9½ × 6½. £2 2s. Hurst & Blackett).

Port Arthur (Three Months with the Besiegers; a Diurnal of Occurrents), by Frederic Villiers. (7s. 6d. Longmans).

The Russo-Japanese Conflict: Its Causes and Issues, by K. Asakawa. (7s. 6d. Constable).

Reflections on the Art of War. 3rd edition, with a Chapter on Mountain Warfare, by Major-General Sir R. C. Hart, V.C., K.C.B. (7s. 6d. Clowes & Sons).

Cavalry: Its Past and Future, by Lieut.-Colonel F. N. Maude, *p.s.c.*, late R.E. (6s. Clowes & Sons).

Staff Rides, by Capt. A. H. Marindin. (5½ × 4. 2s. Hugh Rees).

Wellington's Campaigns, Peninsula—Waterloo, 1808–15, and *Moore's Campaign of Corunna*, by Major-General C. W. Robinson, C.B. Part I. 1808–9–10. Roleia to Busaco. (8½ × 5½. 3s. 6d. Hugh Rees).

The Eyes and Ears of the Artillery, by Colonel C. N. Simpson, R.F.A. (7½ × 4½. 1s. 3d. Hugh Rees).

The Prevention of Disease in Armies in the Field (awarded Parkes' Triennial Memorial Prize), by Major Robert Caldwell, R.A.M.C.

Sanitation and Health. 9th edition. By Major-General Sir R C. Hart, V.C., K.C.B. (1s. 6d. Clowes & Sons).

With the Russians in Peace and War (Recollections of a Military Attaché), by Colonel Hon. F. A. Wellesley. (8½ × 5½. 12s. 6d. Nash).

Recollections and Letters of General Robert E. Lee, by Capt. R. E. Lee. (12s. 6d. Constable).

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Life and Times of Lieut.-General Sir James Browne, K.C.B., K.C.S.I., R.E. ("Buster Browne"), by Lieut.-General Sir J. J. McLeod Innes, V.C., R.E. ($8\frac{1}{2} \times 5\frac{1}{2}$. 18s. John Murray).

Tools for Engineers and Woodworkers (including Modern Instruments of Measurement), by Joseph Horner. (9s. Crosby, Lockwood & Son).

The Other Side of the Lantern (a Tour round the World), by Sir Frederick Treves. ($9\frac{1}{2} \times 6\frac{1}{2}$. 12s. Cassell).

The Great Pyramid: Its Builder and its Prophecy, by Colonel Garnier. (9×6. 3s. 6d. Banks).

Life of the Marquis of Dufferin and Ava, by Sir Alfred Lyall, V.C., K.C.B. 2 vols. ($8\frac{1}{2} \times 5\frac{1}{2}$. 36s. John Murray).

Ambidexterity (Two-handed-ness and Two-brained-ness), by J. Jackson. ($9 \times 5\frac{1}{2}$. 6s. Kegan Paul).

Uganda and its People, by J. F. Cunningham. ($10 \times 7\frac{1}{2}$. 24s. Hutchinson).

Cambridge Modern History. Vol. III. The Wars of Religion. (16s. Cambridge University Press).

Dai Nippon (The Britain of the East: A Study in National Evolution), by Dr. Henry Dyer. ($8\frac{1}{2} \times 5\frac{1}{2}$. 12s. 6d. Blackie).

The Dickens Country, by Frederic G. Kitton. ($8\frac{1}{2} \times 5\frac{1}{2}$. 6s. Black).

History of the Isle of Sheppey, by A. A. Daly. ($7\frac{1}{2} \times 5$. 2s. 6d. Simpkin, Marshall).

With the Pilgrims to Mecca (The Great Pilgrimage of A.H. 1319, A.D. 1902), by Hadji Khan and W. Sparroy. (9×6. 12s. 6d. Lane).

"Verb. Sap." on going to West Africa, Northern and Southern Nigeria, and to the Coasts, by Alan Field. (2s. 6d. Bale, Sons & Danielsson).

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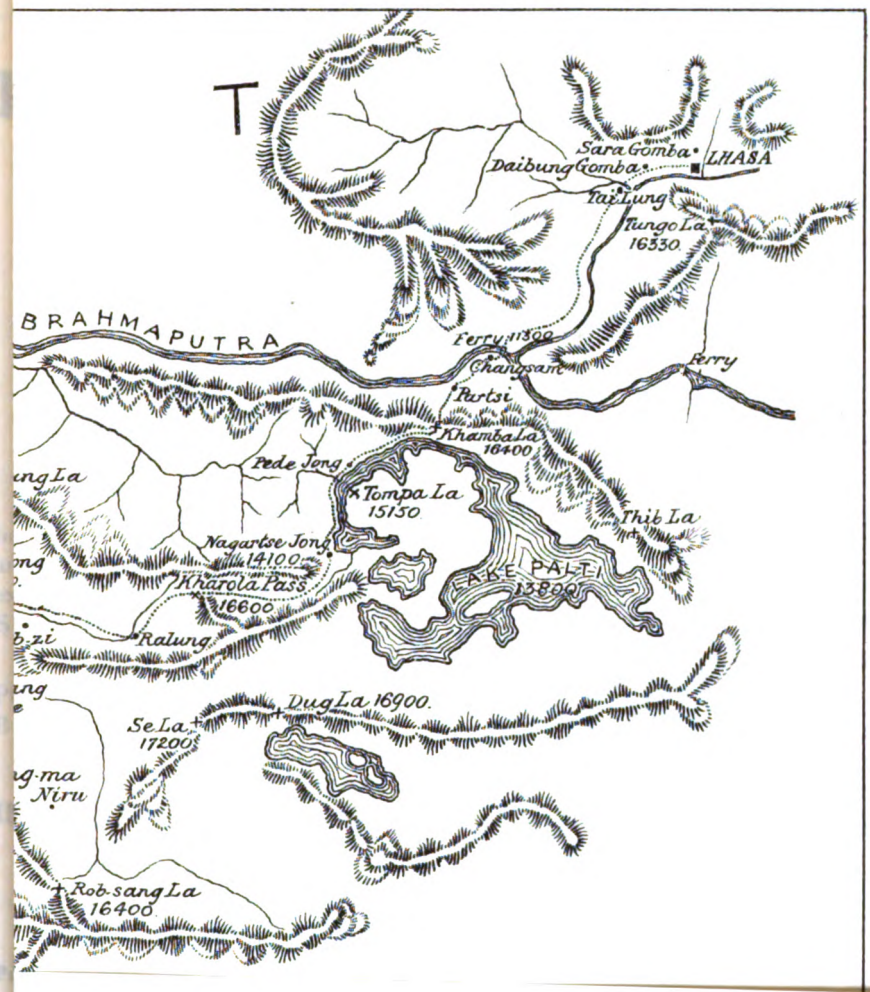

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Militia Literary: G. V. C. Irwin, A. St. J. Wright, M. C. Coote, R. Lechmere.

Woolwich (Dec., 1904): 2nd, F. W. Thicknesse; 7th, O. E. Fane; 24th, C. O'Driscoll Preston. (Two others previously).

Sandhurst (Dec., 1904): 24th, G. de la Poer Beresford; 32nd, H. G. C. Colville; 68th, C. H. Blackburn. (Two others previously).

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*ORGANIZATION OF THE ROYAL ENGINEERS IN AN INFANTRY DIVISION.**

By Bt.-Lieut.-Colonel A. W. Roper, R.E.

In our service we seldom use Army Corps and the Infantry Division becomes the largest unit. The Army Corps despatched to South Africa in 1899 was never used as such, and the various Divisions acted independently or in concert with each other as circumstances directed.

It would appear, therefore, that the Infantry Division should be complete in itself. This is not the case under existing regulations so far as Engineers are concerned. The Engineers in an Infantry Division consist of Regimental Staff and one Field Company; but no Telegraph or Balloon Sections are included.

The Regimental Staff comprises a C.R.E., his Assistant, an Engineer Clerk and batmen. The Field Company numbers *212* officers and men, of whom 54 are mounted and 158 dismounted. It is divided into three Sections in addition to the Headquarter Section, which consists mainly of the Company Staff.

Each of the three Working Sections of the Company should be complete in itself, so as to be thoroughly efficient when detached with a Column. This, however, is not at present the case. For instance, there is only one "Forge, double bellows" with a Company, so that a detached Section has none; yet it is a most necessary article of equipment.

The mounted men are not tradesmen, but are used as officers' servants and as Drivers of the technical vehicles. The Sappers, who are artisans and form the bulk of the Company, are all dismounted and consequently have to march like infantry. They cannot therefore be made full use of on the line of march, as there is no way of carrying them quickly to any place required. Again, on arrival in camp after a long march, they are often too tired to properly carry out their technical work.

There are at present no R.E. in an Infantry Brigade. Yet there is much work which Brigadiers would like done, but for which they have to ask through the Divisional Generals. In action and on Field Days, the latter often appear to have so much else to think about that the Field Company gets overlooked. It seems probable that this would not be the case if Engineers were allotted to each Brigade.

* Since the above was written a revised War Establishment for a Field Company R.E. has been published. It does not however materially affect the principles advocated.

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As regards what is called the Regimental Staff, it is very desirable that the C.R.E. should be recognised as one of the Divisional Staff. This is really essential if the Engineers are to be efficient in forwarding the execution of the General's plans, as it is only through the C.R.E. that the R.E. officers learn what is to be done.

On active service, there are never enough Sappers to carry out the work required of them.

The shortcomings of the present organization may thus be summarised as follows :—

1. The Infantry Division is not complete in itself.

2. The Sections of the Field Company, R.E., are not sufficiently independent.

3. The Company is not sufficiently mobile.

4. There are no Engineers permanently allotted to Infantry Brigades.

5. The C.R.E. does not form part of the Divisional Staff.

Moreover, on active service there are never enough Sappers to carry out all the work required of the Engineer.

The following organization is therefore suggested as one that would be more suitable and more likely to produce the best results:—

1. The Divisional Troops should include a Telegraph Section, a Balloon Section and a Field Park.

2. On the Staff of the Division there should be a C.R.E. with an Assistant and a Clerk.

3. Each Brigade should have a small Field Company of its own, commanded by a Major and consisting of about 120 of all ranks. It should be divided into two Sections, each of which should be complete, so as to be thoroughly efficient when detached.

4. Every individual should be either mounted or carried in wagons. Probably the latter method would be the better; on arrival in camp the Drivers would look after the horses and the Sappers would be available for their legitimate work. Tools could be carried in the seats.

It would be necessary to guard against the danger of the Sappers degenerating into Pioneers; and every effort should be made to keep up a high standard of trade qualifications.

5. The R.E. Divisional Troops, for purposes of discipline and interior economy, should form one unit under a Major; but they should be under the orders of the C.R.E. for their employment.

The Field Park would carry a small reserve of stores for the use of the Brigade Field Companies; it should also have some bridging equipment and a good deal of water-supply equipment. The Sappers belonging to it would have to do any work required by the Headquarter Staff and Divisional Troops. The Field Park should be about 100 strong and might be commanded by a Captain. The men should be carried as in the Brigade Field Companies.

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*THE SCIENTIFIC STUDY OF MILITARY HISTORY.**

By LIEUT.-COLONEL F. N. MAUDE, *p.s.c.*, LATE R.E. (O.C. 1st HANTS R.E. VOLS.).

WHEN a little more than thirty years ago I joined the R.M. Academy, France and Germany were just emerging from a war which differed very materially in its conditions from any which had occurred in previous history, and all military Europe was busy trying to find the solution of the many and apparently startling phenomena the struggle had disclosed.

The method in which the different nations approached these problems differed materially according to their several standpoints. Whilst we in England had to rely almost exclusively on hearsay evidence, often of a most unsatisfactory character, the French and Germans at least knew on the testimony of eyewitnesses the actual facts which had to be dealt with. But all were practically alike in this, that the number of men in any army capable, by personal experience, of drawing conclusions between the new phenomena and the old was most surprisingly small; because during the long peace from 1815 to 1870 the continuity of warlike tradition had been almost completely broken, and, except in America, there had been nothing in the interval approaching a real "struggle for existence" between two well-matched nations.

It happened to me, whilst still a cadet at the R.M.A., to be put on the track of a solution of the many conflicting theories, though I must confess that it took me quite twenty years to discover the full significance of the knowledge of which I had then become possessed.

I was staying with some German friends at Constance, where I had previously been at school; finding the young Englishman very keen to pick up information, they were good enough to tell me many of their personal experiences, which did not at all tally with the impressions I had received from newspapers or books. One day an experienced soldier, many years my senior, found me reading one of the numerous pamphlets to which the war had given rise—Boguslawski or Tellenbach, I think it was—whilst waiting in his study; he went to his bookshelf and took down Clausewitz's *Vom Kriege*, and giving it to me with one hand whilst with the other he removed the pamphlet, he said: "There, if you want to learn what War really is, study that; don't waste time over those others." I took his advice; and though it

* Lecture delivered at the Royal Engineers Institute on 13th Oct., 1904.

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was long before I began to understand the book, constant reflection, aided by the help I by degrees derived from others, set me on the track of a line of thought which brought me to the investigations I am now able to put before you.

Time is altogether too short to attempt a summary of this extraordinary work, but there are a few points to which it is necessary to draw your particular attention. Clausewitz himself was a man who had not only enjoyed an almost unequalled experience of war but had seen the destruction of an old and time-honoured system and the resurrection of a new one; he had been trained in the "school of defeat," and witnessed the gradual evolution of the spirit of victory; and had prepared his intellect, naturally a remarkably clear one, by the highest training the educational system of Prussia could give him, to deal with the phenomena his opportunities had presented. He had seen all the old empirical rules for securing military successes swept away by the board, and had realised the necessity of substituting some more scientific method of investigation than any previously in force, in order to fulfil his duties as head of the Prussian "Kriegs Akademie." His work remained incomplete at his death, but as far as it went it represented the last word on the subject that the methods of thought of those days could reveal, and, though weapons and other means employed in the making of war have changed, no one has been able ever since to add essentially to his book.

He lays down no pedantic rules for observance, but investigates the forces which encounter one another in war and the materials these forces employ, shewing the variations of strength to which each is liable and their interdependence one upon the other. Like an engineer, he asks, "What is it I am asked to do?" "What are the forces I have either to employ or overcome?" "What materials are available for my purpose?" Transfer the analogy to the building of a bridge, and the idea will be clearer.

Your task is to construct a bridge across a given river, to carry certain loads. The forces against you are gravitation, which is known, the power of the stream, with its influence on the banks, etc., of wind and its pressure on your girders and so forth, and the combinations of other natural forces which condition the reliability of your foundations, all of which may or may not be known within reasonable limits of variation. The materials at your disposal are steel, iron or wood, as the case may be, whose strength can be estimated within very reasonable limits. The *Art* of the engineer consists in putting the materials at hand to the best practicable use for the attainment of his object; and he is guided in the exercise of this Art by his knowledge of the sciences, which explain the strength of materials, their fashioning, action under different strains and stresses, and so forth. The final success of the bridge will be in accordance with the soundness of his knowledge of all these matters, *e.g.*, if he thinks that wrought iron

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is the same as best steel, he will be exceedingly likely to find all his bridge some fine morning in the river bed.

Years after Clausewitz's death von Moltke, being asked to define the Art of War, said: "The Art of War is the Art of making the best practical use of the means at hand to the attainment of the object in view." I think it was the discovery of this phrase and the realisation of all that it meant, which came home to me like a flash one day when standing by the engineer of the Sutlej Bridge, at Ferozepoor, then under construction and in momentary danger of being swept away by a tremendous flood coming down the river, that led me to the second step of my investigations. The history of the bridge had been as follows:—Its construction had been recommended years before, and project after project made, but the difficulty was that time was the essence of the situation; the only time available was from the end of the rains to the *chota bursat*, during which the river bed was practically dry, and no engineer would undertake the responsibility of attempting to erect the girders on a temporary staging in the dry river bed, with the chance of a flood coming down and destroying the whole plant. Hence all the designs contemplated "building out," and were immensely expensive in consequence. Then at last Colonel Conway-Gordon, R.E., and Mr. James Bell, C.E., foregathered, and determined to take the risk. The bridge was duly designed and erected in England, and then sent out in pieces to be put together, each one of course duly labelled so that no time should be lost in sorting them out. But the best-laid plans often break down; the cargoes arrived successively all in confusion; and to crown everything the floods came on a few weeks sooner than observation had led them to be expected, and in the end it was a matter of minutes literally whether the last bolt could be got into place or not. At last it was fixed, and ten minutes later not a vestige of the staging remained; it was all swept away down stream; but the bridge stood, and that was the one consideration.

It seemed to me, as I thought it all over afterwards, that here was the nearest imaginable approach to the conditions of warfare; and I set to work to see how what I knew of engineering might be worked in to help me in constructing, for my own guidance, a theory of the "conduct of war." Foundations, organisation, design, all found their places easily enough, but the ultimate reason why the bridge stood was the knowledge of the strength of materials possessed by its designer; and here my analogy broke down completely.

The General's materials are battalions, squadrons, batteries; but military history, and that collection of empirical rules for conduct which we in England always call "strategy," invariably treat these units as known factors of constant value, whereas experience shews that they are susceptible of almost infinite variation. It seemed to me therefore that an investigation into the strength of our materials and the

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best methods of forging, welding and tempering them should form, at any rate, the preliminary portion of my proposed inquiry.

Endurance under fire being the prime condition on which a leader bases his plans, it became necessary to tabulate such figures as were available, and see what data could be derived from their study.

The broad results arrived at are shewn in the diagrams.

No. I. shews the nature of the stress, measured in bullets per minute per yard of front, to which the troops have been subjected. Here I want to point out this curious fact, that, in spite of all variations and improvements in weapons, the actual number of bullets discharged per minute per yard of front has remained nearly constant;* because the advantages of holding as wide a front as possible have always been so obvious that every improvement in rapidity of fire has been immediately seized upon in practice to economise men in the fighting line, so that the test, as regards frontal fire only, has remained much the same, though duration of exposure and degree of convergence, both dependent on the length of range, points to which I shall recur hereafter, have varied very largely.

No. II. shews the variation in the incidence of losses, tabulated in percentages per hour, which is obviously a better criterion of the intensity of strain than percentages per battle, for 40 per cent. in three days' fighting means actually less strain on the troops engaged than 10 per cent. in one hour.

No. III. is simply a rough chronological chart to assist the elucidation of No. II., and one's military reading generally.

Of course these are only rough approximations. To compile accurate curves would entail the labour of a whole historical section of an efficiently equipped General Staff for years; but they suffice to establish limits of error, between which one can, as information is added, gradually approximate more and more closely to the absolute truth. This is simply the "scientific" as opposed to the "logical" method of investigation which has hitherto been exclusively applied to military research. The "logical" method, which is practically that of the law courts, is useful for determining actual matters of fact; but military problems are in their nature most frequently "indeterminate," and the most one can hope to do is, by collecting a sufficient amount of data, to establish a generalisation which will approximate as closely as possible to the ultimate truth.

Returning to diagram No. II. Whereas at least nine-tenths of the writers who endeavour to educate public opinion are evidently under the impression that the constant improvement in weapons must lead

* I do not claim priority of discovery in this matter. Colonel Hime, R.A., in his *Stray Military Papers* brings it out with equal force; but since he was good enough to say that he derived the idea from me, though I cannot trace it myself, I think it may be considered a case of simultaneous discovery.

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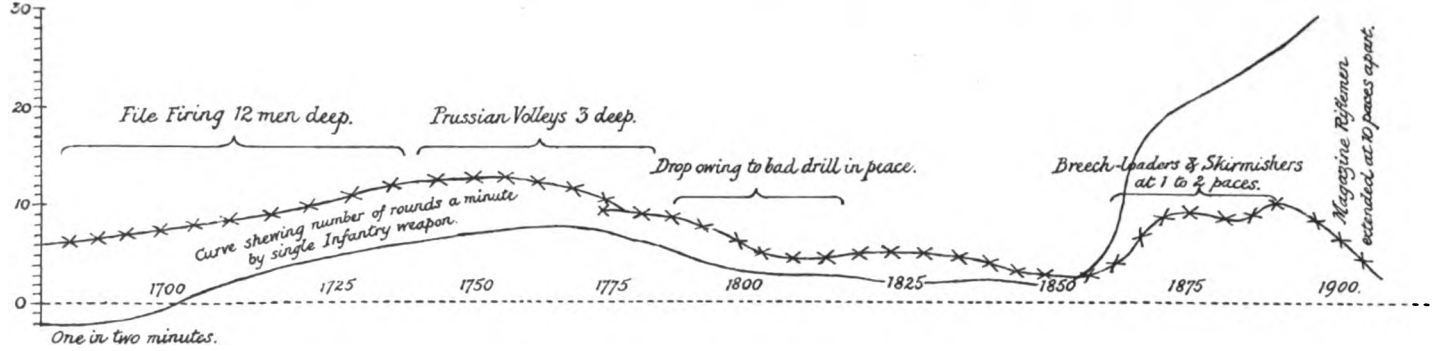
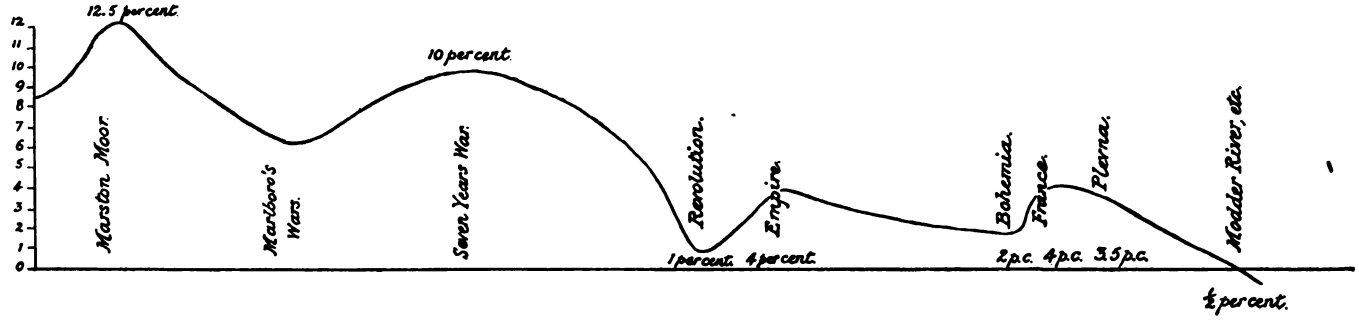
I. DIAGRAM SHEWING, *FULL LINE*, RATE OF FIRE OF WEAPONS INDIVIDUALLY.
CHAIN LINE - NUMBER OF BULLETS PER YARD DELIVERED BY NORMAL FIGHTING LINE PER MINUTE.



II. CURVE OF LOSSES PER HOUR AT VARIOUS PERIODS FROM TYPICAL INFANTRY BATTLES.



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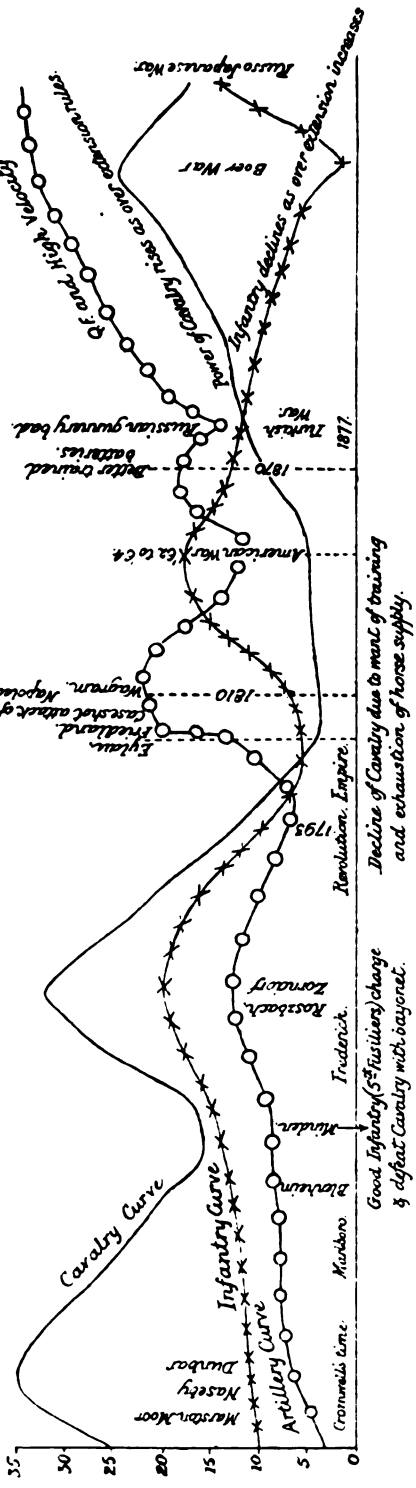

III. DIAGRAM SHEWING RELATIVE POWER OF THE THREE ARMS.

to such unprecedented slaughter that War will become impossible, the actual facts when grouped together shew that the exact converse is the case. Battles are certainly less bloody now than they were 150 years ago. But a further reference to the table shews that the variations in slaughter were actually greater in the days when the armament was a constant on both sides than it has been since new arms have been introduced. On the other hand, I can find no evidence whatever to support the assertion—very freely made—that men are less brave nowadays than they were in the past. As far as a single man can collect and collate the facts, individual heroism is quite as common and fully as admirable as in the past; hence, as there are only three possible variants in question—arms, men and training—, and two have been shewn not to affect the issue, the third (the collective training, *i.e.*, drills and tactics) must be responsible for the change. And now let us see how history supports this conclusion.

I need not take you back to Marston Moor; there cold steel still played the decisive part, and the obstinacy of the combatants, drawn both essentially from the same race, will sufficiently account for the result. The times of Marlborough and Frederic, when fire power had already established its supremacy and steel—to quote the saying of the latter—was "*peu de chose*," will amply suffice for our

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present purposes. The infantry had already become a highly mobile manœuvring body, equally well armed, raised and disciplined substantially on similar lines. The guns were still in a state of chaos; and though the idea of artillery preparation was in the air, want of mobility in the weapons themselves and of discipline in their drivers reduced their power to very little indeed, except in defence, where, arranged in big batteries of the old siege type, 18 feet from centre to centre, the grape and case from 24, 18 and 12 prs. (the usual calibres) formed a terrible stumbling block to the attacking infantry.

Marlborough's Wars were fought out mainly in the Netherlands, a cramped and confined district which hampered mobility and never gave time for one side or the other to entrench itself; and a glance at the numerous battle and campaign plans of the period (see Müller's *Fortification*, 1716, the first textbook in use at the R.M.A.) will shew how ready they were to avail themselves of these opportunities. Lines grew up 50, 60 and more miles in length of ditch and parapet, defended by every conceivable obstacle, a real "physical impediment to assault," not merely "cover from fire"; and since the rate of infantry fire was still relatively slow, these lines were broken into salients and re-entrants, bastions, etc., till the assaulting columns had often to face a threefold cross fire before closing; and though the pointblank range of the musket was short, only about 200 yards, the bullets even then carried sufficient remaining velocity up to 800 and 900 yards to inflict serious and shattering wounds.*

With practically no artillery available to prepare the way, assaults became so terribly bloody that practically War came to a deadlock, and positions could at length only be captured by stratagem; and it is worthy of note that it was at this time that the word "strategy" made its first appearance in the sense of the employment of stratagems—a meaning which still attaches to it in this country, though it has long since been extinct in all others. Marlborough's capture of the "*Ne Plus Ultra*" lines is the finest example of this particular type of leading, and will be found very fully narrated in Fortescue's *History of the British Army*, a book I cannot too warmly recommend.

During the years which followed the cessation of hostilities the Prussians were developing a new departure in infantry tactics, which, favoured by the nature of the country in which it was first employed, completely upset the existing relation between attack and defence. By the most incessant and accurate drill, and by the adoption of the simple expedient of a heavy cylindrical iron ramrod, they brought up the rate of individual fire to five and six rounds a minute against two, the normal in other armies. The

* See the many tables and data collected by Max Jähns in his *Geschichte der Kriegswissenschaften.*

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relative advantage this conferred on them was far more than the mere numbers suggest; for, assuming the first volley on each side fired simultaneously and with equal effect, the second Prussian one would catch the enemy whilst still loading, and by the confusion it created delay the process, so that a third and fourth might go crashing in before the enemy could pour in a second fire. But at short ranges two or three *good* volleys usually did the work—the enemy seldom waited for more. A further advantage accrued to the Prussians from this ceaseless effort, which perhaps carried them further even than their fire. The discipline they acquired incidentally made them more mobile and staunch than their enemy, and losses which would have stopped the latter proved quite inadequate to check them. Their mobility, helped by the nature of the country, deprived the enemy of the opportunity of entrenching, or enabled the Prussians to march round such entrenchments as were made; and their superior discipline enabled them to dispense with the preparatory action of artillery, so that the relative advantage of attack and defence were reversed and for a time the former had a decided ascendency.

These duels between infantry on the one side against infantry and artillery, both generally more or less entrenched, proved terribly costly to the former. Hence, as the war went on and the numbers of his enemies constantly grew, Frederic had to reduce the number of his men to the yard to oppose an equal front; as these men were no longer of the same skill or training as their predecessors, so again the defence overtook the attack, and the deadlock which had existed in Marlborough's time again arose.

The chief point to notice in the tactical methods of these days is that they were deliberately adopted by one of the greatest generals in history as ultimately the most economical to the State; and if they were expensive in life to the army, that was because the conditions of the time left him no alternative. His battles were uniformly designed to ensure that the maximum possible number of men should find useful employment. His casualty lists were not unnecessarily swollen by chance hits amongst crowds of reserves, for the discipline of his men allowed him to reduce these to a minimum. He strove to crush his enemy by a single blow, not to reduce him by attrition (see Malachowski's *Scharfe ü Revue Taktik;* Berlin, 1890).

In the early wars of the French Revolution, though the weapons remained the same and also the tactics, for all nations had copied the Prussian model on paper, an entirely new factor made its appearance, which owed its existence to the social upheaval the French nation was undergoing. For them it was no longer possible to find and pay men for the two years' drill which was necessary to acquire the standard of rapidity in firing demanded by the tactics of the line. They had to raise men and compel them to fight as best they could, and though

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they tried to make them fight in line, the experiment broke down on the battlefield. Their men had not the cohesion to advance closing their files as the casualties increased; but the bravest went to the front, whilst the less brave straggled behind and were rallied and led forward in "clumps" by the older war-seasoned veterans who still remained from the ranks of the old Royal Army. Ultimately this system or want of system was fused into the framework of the light infantry school, which, though it had existed more or less all over Europe since the beginning of time, had been developed and perfected by the French and ourselves in America and Canada; but whereas in these wars the nature of the ground and experience had turned the disciplined soldier into the skilled skirmisher, the early French levies were neither disciplined nor skilled, but fought by the simple light of nature in long orderless lines (like a "lot of beaters," as an old French general declared), advancing and retreating but never closing, until their numbers gradually overlapped the enemy's flanks and compelled him to retreat without being either broken or defeated. Numbers played for the French the same part that mobility played for the Boers in South Africa, and the war took a very similar course.

The French, living on the country and having no supplies to guard, swarmed all over the district, whilst the allies, having by tradition to pay for everything they wanted—even hire for the camps and houses in which they lodged their soldiers—were hampered by their provision trains and the necessity of guarding their depôts. If they were victorious they could not pursue, for the French ran away too fast and left no supplies behind them, whilst, if beaten, the French found all the supplies they needed in the captured position or camp.

The war resolved itself into a series of small column and detachment operations, armies of 30,000 men fighting in groups over a front of thirty miles with no decisive results; and whilst, as the curve shews, the percentage of loss per hour was insignificant, the aggregate loss to the nation was very heavy indeed.

In the process the French, unhampered by tradition and aristocratic prejudice, evolved a system admirably suited to their national proclivities; and when Napoleon appeared on the scene, he found ready to his hand a war-seasoned, supple army and subordinates ready to obey unhesitatingly, without making difficulties, but equally ready to assume responsibility when their trained judgment shewed the necessity.

His first great successes were achieved by purely strategical methods. He massed numbers against the decisive point and left his subordinates to do the rest. It is noticeable that up to 1806 the fighting fell mainly on his infantry; he never possessed a cavalry really fit for the battlefield, and his artillery he had not yet learnt to use. Battalion guns had indeed been abandoned and his batteries had made great progress in mobility; but though in a sense everyone

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realised the importance of masses of artillery, the way to form those masses had not yet become part of the flesh and blood of the arm itself.

The idea only took shape after Eylau and Heilsberg, where, against the stubborn Russian infantry, all efforts of the attacking infantry had failed. It was first successfully employed at Friedland by Senarmont at the head of the Guard Artillery, who, galloping up in advance of the columns of attack, simply blew a hole out of the Russian line with case fire; and ever afterwards the same manœuvre was employed, till it became conventional in every Continental army, with consequences to be referred to in the sequel.

But now the deterioration in the French infantry began, the drain on the country had been enormous and the service was becoming intensely unpopular. The conscripts no longer went into action with the same spirit and could not be induced to advance except in heavy columns, which, of course, drew a convergent fire. All other armies, too, except the British, had had to be re-cast to meet the hosts the French continued to bring against them, and since there was no longer any time to train the men for the line they, too, had to fight in column; and thus step by step the density of the opposing forces, which in Frederic's time had been from about 10,000 to 15,000 men to the mile, went up to 40,000 and even 50,000, the consequence being that more men being exposed more men were hit, quite irrespective of whether they were doing useful work in the fighting line or looking on as spectators in rear. This accounts for the rise in the curve on the diagram; but it will be noticed that, whilst the percentages are still only half those of Frederic's time, the totals at Wagram and Borodino began to exceed the worst of the old Seven Years' battles.

The British army came late on the scene, having evolved in years of experience all over the world a perfect system of skirmishers for introductory fighting, whilst retaining the line as the true decision-compelling weapon in the hands of the leader. But it was numerically so small, and foreigners were so entirely absorbed in their own affairs, that its victories and the tactical teaching they involve passed unnoticed across the Channel, where, after the final victory of Waterloo—in which, being on our part a defensive action, the line was not seen at its best—all Europe settled down to a sleep of exhaustion, and tactical study ceased for a full forty years.

Everyone went on where Napoleon had left them, and when at length the long peace was broken and the Prussians marched into Bohemia, and four years later into France, they went into action practically with the same formations and distances as at Waterloo. They were victorious, and Europe jumped to the conclusion that the same foresight that had provided their infantry twenty years before the rest of the armies of the Continent with breechloaders had also supplied the tactics best fitted for their utilisation. In this we

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were all totally mistaken. The Germans really owed their victories to the organisation which had provided, and the strategical skill which directed, superior numbers upon the decisive point.

The Prussians themselves fell into no such error; they knew only too well the haphazard nature of their tactical leading, and realised keenly by how very narrow a margin they had escaped defeat. But though they commenced investigation almost before the war was over, so great had been the break in continuity of tradition and so complete the absence of scientific method in their inquiries that it was a good ten years before they began to collect the evidence a proper solution of the new problems demanded, and officially the promulgation of their conclusions is wanting yet.

Probably this slowness can be accounted for by the absence of a sufficiently formidable resistance to the dominant trend of opinion. "They had been victorious, therefore they were heroes," as Dragomiroff, the great Russian writer, the first almost in Europe to remind his readers that the dominant factor in victory is a psychological, not a technical one, pointed out; and when once each writer had promulgated his contention that all was for the best in the best possible of worlds, he was content to leave his research at that point and settle down to the enjoyment of a more or less well-earned notoriety.

Only the cavalry, who had not come well out of the war in their own opinion, insisted on further information. They wanted to know why either men or horses should be more afraid of a bullet because it was loaded at one end of the barrel rather than the other. They did not raise the question of the actual numbers of the bullets to be encountered or their distribution in space, but contented themselves with pointing out that the danger on a battlefield where ten men fell in an hour must have been considerably greater than on one where 4 per cent. (Mars la Tour) seemed an outside possibility in the way of risks. This led to a digging up of the old Frederician material in their archives, from the results of which I have borrowed the bulk of my data in the first part of this paper; and then a number of questions began to obtrude themselves which clamoured for immediate reply.

The men of Frederic's army were recruited mainly from the lowest class, and certainly did not fight from any exalted feeling of patriotism, but chiefly from a very real and lively fear of the stick. Yet they excelled all records in the heroism with which they faced punishment in the field. There were veterans amongst them certainly, but after 1870 belief in the veteran had rather died out. Could it be that there was something wrong with the modern system of recruiting by compulsory service which for so long had been the pride and glory of the Fatherland? The idea was not a pleasant one, but it undoubtedly bore fruit in the increased intensity with which the drilling of the

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recruit was henceforward carried out. They then turned to the alternative horn of their dilemma and began to ask whether, after all, the last word in the conflict between line and column—small columns and skirmishers—had been pronounced. In this inquiry Meckel and von Malachowski took the lead, and von Scherff followed with proposals which logically could only lead to the same result. Hoenig, whilst giving ample evidence in support of these views, refrained, to the best of my knowledge, in formulating any definite conclusions. All saw the hopeless unwieldiness of the continuous line under certain conditions, and equally the practical impossibility of imparting a simultaneous forward movement to a body consisting of innumerable small units, each led by the independent initiative of its commander; but whilst all more or less combined to condemn their existing regulations (Scherff, indeed, going as far as to say that, if logically adhered to, the German infantry could only hope for success if it had the good fortune to encounter an enemy whose regulations were even worse than their own), they all alike ignored the changes in the relative power of artillery and infantry, which, as between armies equally well-found in weapons, give to the attacking general the power to create conditions to suit his materials.

This is the point on which I now desire to focus your attention. Turning back to the diagrams and what I have said in explanation of them, it will be seen that in Marlborough's time it was the defender who created the tactical conditions to suit himself. In Frederic's era increased mobility robbed the defender in great part of this power; but owing to the low degree of manœuvring skill in the artillery, the ultimate decision had to be fought out between the two infantries; and further, owing to the short range of the weapons, they had to settle the matter on more or less equal fronts, the degree of convergency attainable being too small to exercise much influence. Hence the obstinacy and bloodiness of their struggles.

In the early days of the French Revolution the material on the French side was too heterogeneous to allow of combined direction under a single will, and battles became a tedious conglomeration of insignificant skirmishes; and it was only when Napoleon and his artillery officers, Drouet and Senarmont, lit up the idea of massed batteries at case-shot ranges that it became possible for the commander to suit the task he set them to the staying power of the attacking troops.

Then presently the balance between the arms was completely upset by the introduction of the long-ranging and relatively accurate muzzle-loading rifle, which effectually prevented the opposing artillery from unlimbering at case-shot ranges; and in the American Civil War, local conditions favouring the construction of entrenchments, the defence re-asserted its power, and the struggle between the contending infantries became locally as bloody as they had been in the past; but

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it will be noted that the fighting was spread over a much longer period of time.

In the Franco-German War mobility, conditioned mainly by the number of good roads, again very generally robbed the defenders of the opportunity of entrenching, the common shell of the guns being a far less effective man-killing projectile than case at 300 yards, the commander no longer had it in his power to ensure with rapidity and certainty the destruction of the defender's power of resistance; and the fighting again reached a high degree of intensity, though still falling far short of what it had been in Frederic's day.

In the Russo-Turkish War mobility again sank very low, bad roads and a clayey soil making rapid turning movements of large bodies almost an impossibility; hence, again, the defenders had leisure for entrenching, and as there was a great want of tactical skill on the part of the attacking artillery, the two infantries, as before, were left to fight the matter out between themselves; but though the power of the weapons had been greatly increased since 1870, the slaughter was no worse, hardly as bad (except in the special case of the second battle of Plevna, the figures for which are quite unusual).

The Boer War was conducted under such abnormal conditions of mobility on the two sides that its results need scarcely be taken into account. Superior mobility enabled the Boers not only to select their positions, but also gave them time to entrench; and their power of rapid withdrawal when threatened with actual assault introduced a factor hitherto unheard of in war. Thanks to this power, they could hold enormous fronts with a small number of men, because their power of evasion guaranteed them against the usual consequences of having their front penetrated.

In the war now raging in Manchuria we are back on more familiar ground, and find as a consequence of the increased power of preparation due to shrapnel shell, which at 3,000 yards has the same effect as case of equal calibre at 300, that the attack has regained almost, if not quite, the relative advantage it held at the end of the Napoleonic period; but again we note that the slaughter per hour is not so great or the result of defeat so disastrous, probably owing to the absence of a cavalry good enough to reap the harvest of success.

Now the one relation which seems to hold good throughout these periods appears to me to be this. The greater the range of the weapons in use, the less rapid the loss; and the explanation of this relation leads to other conclusions of a somewhat remarkable nature.

In the days when 200 to 300 yards was a medium fighting range it is evident that the power of convergence on any chosen point of attack was very limited indeed as compared with what it has since become with infantry ranges of 1,500 and artillery of 5,000—10,000; a glance at the diagram makes this clearer than much explanation. It is also evident that for equal numbers on the arcs the chance of the

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individual shot on the defender's side attaining any human billet is immensely reduced, even assuming equal accuracy for the two weapons.

But the power of arranging a convergence of fire in advance is the special attribute of the attack, and it is as much easier to arrange when the ranges are a mile and upwards as it is easier to approach a black buck to the same distance than to get within pointblank range. The opportunities for concealment increase with the area; and whereas in the old days attempts to overlap a flank were always dangerous until the defender's cavalry had been thoroughly beaten, nowadays cavalry, with 1,000 yards of open to cross and fresh troops at the end of it, has practically no prospect of success at all.

As between two parallel fronts, the rate of fire with equal arms matters nothing; it is only the difference in accuracy which decides, and this should be initially on the side of the defender, particularly in a prepared position. But convergence eliminates the errors of direction, whilst divergence increases them, and hence the greater the range of the weapons the greater the advantage derived by the attack.

Moreover, and this is a point which I submit has hitherto been most unaccountably overlooked, the effect of unsteadiness of hands and nerves reduces the chances of unaimed fire hitting anything in a very remarkable degree. Thus, if we assume two lines of infantry, one armed with the Lee-Metford, the other with Brown Bess—and both reduced by the excitement of action to such a condition of unsteadiness that at the moment of discharge their barrels point at random anywhere between 30° elevation and 3° depression—then all the bullets of the latter line would reach the ground somewhere within 1,000 yards, whilst those of the former would be disseminated over a surface not less than 5,000 yards in depth and would attain an altitude roughly of 5,000 feet. Imagine at any given instant of time, in each case, the whole of the atmosphere frozen solid and the bullets suspended in space at the points they at that moment occupied; then now move your line of infantry through the shot-filled space and note the difference of the random hits they would receive in the two cases. There being fewer bullets per cubic unit in the larger space than in the former, the chances of a man and bullet coinciding in their endeavour to occupy the same spot would be materially less.

It will perhaps be said that battles are won by *aimed* fire, not by chance hits, but the evidence available seems to me to point to a different conclusion. The chance of hitting a particular mark must vary as the product of all the disturbing causes. The apparent size of the target varies inversely as the square of the distance and the difficulties of judging distance, effect of wind, light, etc., error in any one of which will carry the bullet off the target. Theoretically I see no means of arriving at a satisfactory formula, but it seems to me that a ratio might be obtained by practical experiment up to extreme ranges at a constant rate of fire. What conceals the issue in ordinary

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practice is the neglect of the time factor altogether; the further the range the longer a man requires to get his aim, and in peace the bigger the bull's-eye at which he fires.

Eliminate these disturbances and the results would, I think, be surprising; for, taking the average of many registers, I find that a man will make about the same percentage of hits at 200 as at 500, firing in the same position, but the number of square inches in the bull's-eye are 113·1 and 452·4 respectively. Taking all factors into consideration, I think it would be found that the difficulty of hitting a particular target varies inversely nearly as the cube of the range; and I submit the suggestion here in the hope that it may attract the attention of some of the mathematicians of the Corps infinitely better qualified than myself to undertake the investigation.

Assuming, however, that I am substantially correct in my solution, when we come to investigate the number of bullets required in practice to put a man out of action at different ranges, we find that it follows no such law. Thus the best figures attainable shew that, whereas in the days of Brown Bess (average range being about 200 yards) the average expenditure of bullets per casualty was 200, in the Franco-German War (average range 400) it was about 800, in South Africa (decisive range 800) about 10,000; three figures which have no apparent mathematical ratio to one another, but which, plotted on a diagram, fall far within a curve of cubes; the inference seems to me that it is quantity of fire, not quality, which mainly decides in a general action.

Having taken the collective figures for a number of battles, the next step should be to determine them for each stage in a particular typical battle; but here the data are almost altogether wanting. The only approximate facts I can ascertain are these. The expenditure of ammunition at Omdurman has been calculated at 60 rounds per Mahdist (all due allowance having been made for artillery practice), the mean range being 500 yards and the target quite unusually favourable. Since in this case our troops were quite unshaken by artillery fire and were probably superior to any in Europe at the present day, I think this may safely be taken as the worst which troops can be called on to face, if prematurely committed to an assault against an unshaken defender; and whatever their gallantry the result would be annihilation, just as it always has been against unshaken infantry all the world over, the sole difference lying in the distance at which the assailants have been stopped.

At the other extreme of the scale come cases from the latter half of the Franco-German War, where it took 100,000 rounds and upwards to disable a single assailant; worse shooting than this, I take it, one is never likely to encounter anywhere. But the point I am endeavouring to make is this. Every increase in the power and range of weapons by lengthening the arc of convergence, and every additional

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rifle or gun brought into action, increases the prospect of reducing your enemy's fire to this lowest limit; but if, to increase the difficulty of hitting each single man, you adopt widely extended formations, you diminish the causes at work which produce inaccurate fire on his part. Men at 20 paces apart are practically powerless against men at 1 pace only, for their fire can do next to nothing to unsteady the enemy's aim against them.

As against European infantry, therefore, with no ponies at hand to secure their evasion, you are deliberately throwing away one of your main factors of safety if you omit to oppose your enemy from the outset with as many rifles to the yard of front as he can oppose to you;* and, further, you must arrange to keep your first line at its full strength, so that the storm of aim-disturbing causes should not for a moment be diminished.

Undoubtedly by so doing you increase the number of men exposed; but in proportion as you succeed in reducing your enemy's fire to the lowest limit, the influence of the target in drawing aimed fire diminishes, till, when the bullets are falling simply like rain on the just and unjust alike, it does not signify in what order you group your men at all, and only the duration of exposure and total area of the target conditions the hits.

It would be easy to shew, by calculation, that by too great extension you can eliminate all the advantages the increased power of convergence confers; and then, since the power of preparation would fall to a minimum, the enemy's accuracy of reply would approximate to its maximum. Your advance would be indefinitely protracted, and ultimately you would lose a larger number of men out of your whole army than by the bolder method I have advocated.

I am speaking of decisive attacks only—attacks meant to shift the enemy bodily, not merely to reconnoitre his position. For these latter the old rules of the famous Light Division still hold good, distances only requiring to be adjusted to suit the new conditions of range. But the essence of the matter is this. These preliminary operations, which are meant only to fix in detail the enemy's positions, should not be confused with the attack proper, which is intended to crush him absolutely. In the former, an approach in such order as will attract the enemy's attention as little as possible is the chief point be to considered; for, his exact position not having been as yet revealed, adequate artillery preparation has not yet been possible, and you are advancing against an unshaken defender, whose fire power is still sufficient to destroy you many times over.

But once the limits of the position are fixed and your general point of attack determined on, you possess nowadays, in convergence of fire

* This is the fundamental principle for the attack laid down in the Japanese regulations.

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due to long ranges, the means of accumulating on that chosen point such a hail of projectiles that aimed fire becomes an impossibility, if only because the dust struck up by the bullets and the smoke of the bursting shells conceal the target from the defender's vision.

When that condition is reached nothing you can do in the way of formations can affect your losses; it is simply a case of the longer you are out in the rain the wetter you will get.

In conclusion I must apologise for the many imperfections of my lecture. I can only plead in extenuation that it is exceedingly difficult to compress the result of 30 years of reflection into the space of only 60 minutes reading.

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A CELESTIAL CLOCK.

By LIEUT. F. C. MOLESWORTH, R.E.

THE accompanying method of finding the time by the stars (without the aid of instruments) was suggested by Major-General Rice (late Indian Army). It has proved very useful to me and to all to whom I have shown it; and will, I hope, prove equally so to readers of the *R.E. Journal.* It has never before been published.

In the following description of the method employed, the apparent motion of the stars is referred to as if it were real, and not (as of course it is) referable to the motion of the earth round its axis. No allowance is made for any difference in the apparent positions of the stars due to refraction or to any other such, comparatively speaking, unimportant cause. For the calculation is of necessity a very rough one, taken by the eye and without instruments; and it is useless to attempt to introduce into it an element, which, while it would add much to the difficulty of the observation, would not make a difference of sufficient moment to materially influence a computation so inherently wanting in extreme accuracy. Nor is any allowance made for the fact that the Pole of the heavens is not situated exactly at the Pole Star, but is (at present) distant some $1\frac{1}{4}^{\circ}$ from it.

The stars used are the Pole Star and the two stars in the constellation of the Great Bear, called the "Pointers," or, to speak more accurately, that star of the "Pointers" which is nearer to the Pole Star (α Ursæ Majoris), henceforward called "A."

The Pole Star is the centre of the clock; the circle described by A in its revolution round the Pole Star is the face of the clock, and a straight line joining A and the Pole Star is the hour hand. Thus in *Fig.* 1, P is the Pole Star, A the Pointer used, U W L E the face of the clock, and the dotted line P A the hour hand.

Speaking roughly, A revolves round P once in 24 hours; it therefore reaches W 6 hours after it leaves U (the point of upper transit), L 12 hours after, and so forth. If for example it is known that A is at U at (say) 5 p.m., it is at once apparent that it reaches W 6 hours later, viz., at 11 p.m., L at 5 a.m., and E at 11 a.m., though of course for some part of the time, *i.e.*, during the day, it would not be visible.

Knowing that A travels from U to W in 6 hours, it is easy to calculate how long it takes to travel over any fraction of this distance. If, therefore, A were always at U at the same time on

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every day of the year, and that time were known, there would be nothing easier than to calculate the time at any hour of the night.

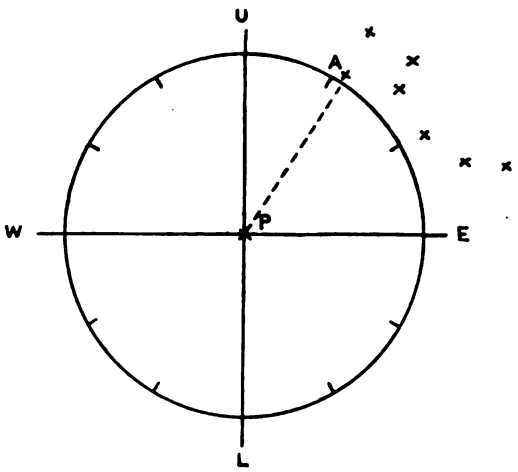

Fig. 1.

But this is not the case. A takes slightly less than 24 hours to complete its revolution round the Pole Star, becoming earlier and earlier every day, making in fact 366 revolutions in a year of 365 days.

Every year on June 21 A is at U at 5 p.m. This gives us a starting-off point; June 21, being the longest day of the year, is an easy date to remember.

One month later, on July 21, A would reach U two hours earlier, *i.e.*, at 3 p.m. On August 21 it would be there at 1 p.m., and so throughout the year. The difference for one month being 2 hours, it follows that the difference for each day is approximately 4 minutes. Hence for any day in the year we can calculate at what time A will be at U. For December 6 which is 21−6, or 15 days before December 21, it will be there at 5 a.m. + 15 × 4 minutes, or 6 a.m. On February 27 it will be there at 1 a.m. − 6 × 4 minutes, or 12.36 a.m.

To take a general instance, suppose that on the night of 29 July A is in the position noted in *Fig.* 2, estimated at rather more than $\frac{1}{3}$ of the way from W to L (point of lower transit). Starting as usual with the datum of A being at U at 5 p.m. on June 21, we find that on July 21 it would be there at 3 p.m., and on July 29, 8 × 4 = 32 minutes earlier, *i.e.*, at 2.28 p.m. It would therefore be at W at 8.28 p.m. We estimate A as being rather more than 2 hours, say 2 hours 20 minutes in advance of W, and we find the time to be 10.48 p.m.

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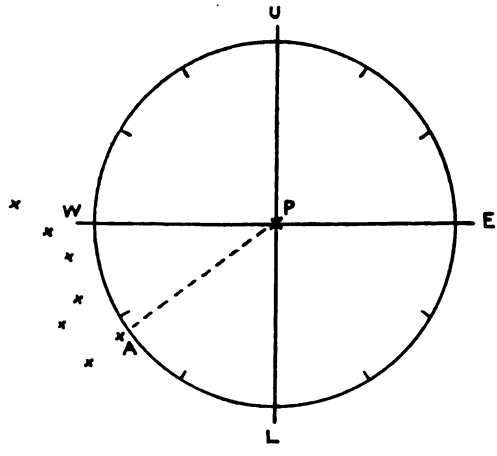

Fig. 2.

In practice the chief difficulty is to tell with sufficient accuracy, without instruments, the position which A actually occupies on the face of the clock.

The best method for ordinary occasions is to hold a swagger cane or riding switch about $\frac{2}{3}$ of the way from its head, letting the head hang down perpendicularly so that the side of the cane nearer to A just appears to cut the Pole Star (*Fig.* 3). As the cane hangs perpendicularly it gives U and L; and if a pencil be placed perpendicular to the cane, so that the Pole Star is just visible in the angle so formed, the position A occupies can be judged with a fair amount of accuracy.

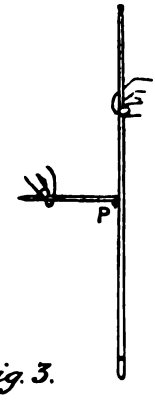

Fig. 3.

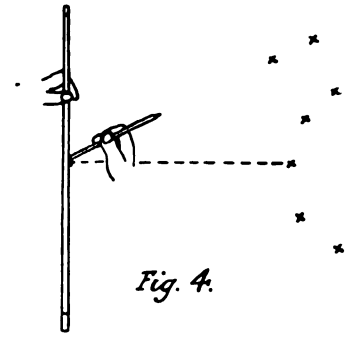

Fig. 4.

For greater accuracy it is sometimes useful to notice some star in the prolongation of the pencil, and, moving the pencil, divide with it the distance between the star and the cane (*Fig.* 4).

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A small circle of cardboard, with projections dividing the circumference into 12 parts and a hole in the centre through which to look, held up by a piece of string so as to hang correctly, will give a very close approximation to the real position of A. The officers of the Guides made small eight-pointed brass stars, which could be carried in the pocket. These however might almost be called instruments.

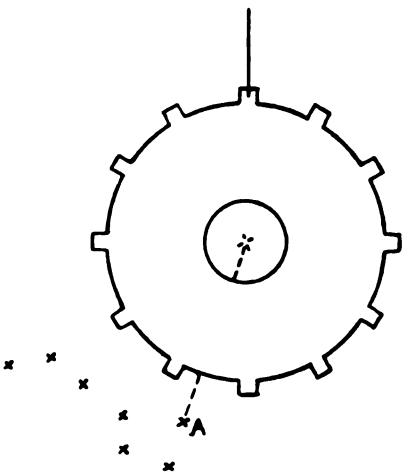

Fig. 5.

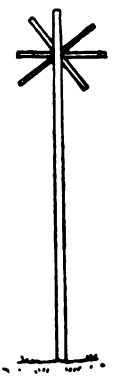

Fig. 6.

But there are other ways; *e.g.*, in stationary positions, as on picquets and outposts, a pole stuck perpendicularly in the ground, with 3 pieces of stick fixed across it (*Fig.* 6); or even, for very rough guessing, one hand held up perpendicularly and the other held up at right angles to it. The side of a house, or even the straight and upright trunk of a tree may often be useful for discovering the positions of U and L.

The rules given above may be summarized as follows:—

1. A is at U at 5 p.m. on June 21.
2. Each month after this date A reaches U two hours earlier, and each fraction of a month 4 minutes earlier for each day of that fraction.

   (These two rules fix the time at which A is at U on any day of the year).
3. In every 24 hours A travels round the circle, traversing each quarter of it in 6 hours, and each fraction of a quarter in a like fraction of that time.

The stars used are of course only visible in the Northern hemisphere. In low latitudes A is often invisible at some portion of the night, rising and setting like most of the other stars.

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When this is the case, I use another star. There is a constellation nearly opposite the Great Bear, on the other side of the Pole Star and about the same distance from it as the Great Bear, called Cassiopeia (*Fig.* 7).

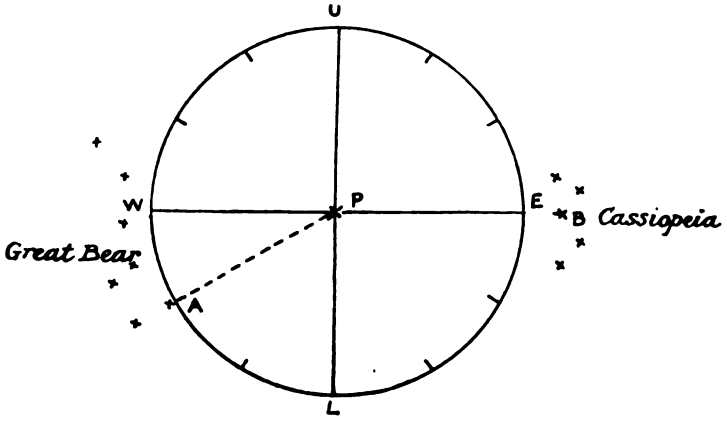

Fig. 7.

It contains 5 bright stars, situated so as to resemble the 5 points of a W. The middle one of these (γ Cassiopeiae), henceforward called B, is the one to use. It is sufficiently correct to say that this star is 10 hours in advance of A; therefore, all that is necessary, when using this star, is to calculate the time by it exactly as if it were A, and to deduct 10 hours from the time so found.

For example, on August 21, A not being visible, I look for B and find it as in *Fig.* 8, which I estimate to be $\frac{1}{3}$ of the way from U to E.

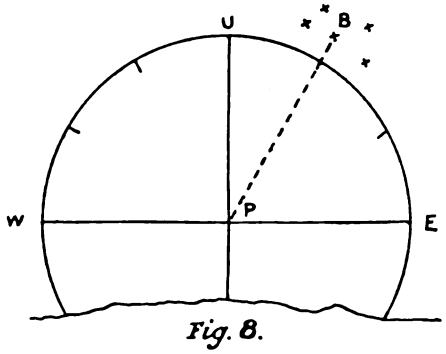

Fig. 8.

By rules 1 and 2 I find that on that day A was at U at 1 p.m.; if therefore it were where B is, the time by rule 3 would be 11 a.m.; deducting the difference between A and B, we find the time is just 1 a.m.

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Hence for low latitudes it becomes necessary to add a fourth rule :—

4. When A is not visible, observe B as if it were A and deduct 10 hours from the time found.

When both A and B are visible, it is not a bad plan to estimate the time from the position of both, and to take the mean of the results.

No allowance has been made for the fact that A and B revolve, not round the Pole Star, but round the true Pole, distant some $1\frac{1}{4}^\circ$ from it. The effect of this is to make the time obtained from "A" observations some 6 minutes slow (an amount which may practically be neglected). There is no appreciable difference in the B observations, as the R.A.s of B and the Pole Star are very nearly equal.

But there is one more correction that may have to be made. Many places do not keep local time, but take their time from some other place (as Greenwich) ; so that for every degree of longitude East of the time-giving station 4 minutes must be subtracted, and for every degree West 4 minutes must be added. At Home, except in the extreme west of England and Scotland, this difference may be disregarded. In India a large number of stations employ "railway" (*i.e.*, Madras) time, and in such cases, unless the place is comparatively close to the meridian of Madras, the necessary correction will have to be made. The longitude of Madras is 80° 17′ E. of Greenwich.

For example, the longitude of Rawal Pindi is 72° 7′ E., being a difference of 8° 10′ from that of Madras. The difference in time is therefore 32 minutes 40 seconds (say half an hour), and this must be added, as Pindi is W. of Madras.

Thus for such places we must add a fifth rule :—

5. In places where time is obtained from another place on another meridian, and which are distant some 3° or 4° or more of longitude from that meridian, 4 minutes must be added or subtracted for each degree of longitude West or East of the time-giving place.

By frequent practice it will be found that these methods give fairly accurate results. The error is generally not more than a few minutes, and rarely exceeds a quarter of an hour.

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THE FUTURE OF LONDON.

By COLONEL H. P. KNIGHT, LATE R.E.

IN the *Royal Engineers Journal* for January last there appeared an article, entitled *The Future of London*, which dealt with the proposal for the construction of a barrage across the Thames at Gravesend as a solution of the Port of London question. This article so ably presents, in a condensed form, the advantages of the scheme as to lead to a conviction not only that they greatly outweigh any possible disadvantages, but also that the scheme itself is the only one worthy of consideration.

It is however admitted that this scheme has been rejected by the London County Council; and it might have been added that it lacks the support of eminent harbour engineers, and that so far the Government has refused to have its merits enquired into.

In view of the enormous advantages claimed for the Barrage scheme, which, with few exceptions, would doubtless accrue on its completion, and which, were it not for necessarily attendant disadvantages, would justify a far larger expenditure than its estimated cost, it appears to be worth while to enquire into the reasons for its rejection.

Before, however, entering into a consideration of these, it may be well to make some allusion to the proposals contained in the Bill about to be introduced by the London County Council, and thereby prevent certain misconceptions with regard to it that might arise from a perusal of the article under review.

The statement that the proposal to purchase the docks is in opposition to the wishes of Dock Companies is not borne out by their action in connection with the Bill that was introduced last Session. The mention of the estimated cost of the London County Council scheme, and later on of that of the Barrage scheme, suggests a comparison between them which is altogether misleading, more than four-fifths of the former being an investment which will presumably bear a fair rate of interest immediately, whereas the whole of the latter represents expenditure which will only become indirectly remunerative in the dim future, if ever.

The amount of dredging contemplated in the Bill is that required to provide a channel, 30 feet deep at low water spring tides and of a width varying from 1,000 feet to 300 feet, from the Nore to the

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entrance to the Royal Albert Docks, and of as great depth as practicable above that dock as far as the old Thames Tunnel.

It is not claimed that this amount of dredging will provide anything like the same facilities for navigation above Gravesend as would result from the Barrage scheme when completed; but in the opinion of His Majesty's Commissioners, based on the evidence of the greatest experts, when these and the other works provided for in the Bill have been accomplished, "the river will bear the same relation to the dimensions of the largest modern ships as it bore fifty years ago to those of the largest ships then existing."

They estimate the cost of this dredging, including suggested moorings and subsidiary works, at 2½ millions of pounds; and state that the proposed deepening of the river as far as the Royal Albert Docks presents no engineering difficulty, and can be executed without risk to the riparian properties, although above that point the question of the safety of property adjoining the river will affect the precise dimensions of the width and depth to be adopted.

The disadvantages of the Barrage scheme may now be considered; and here it is only right to say that they have not escaped notice in the article under review, although the formidable nature of some of them at least is not appreciated.

They may be summed up as follows:—

(1). Interference with the natural means of drainage, including the fouling of the river with sewage.
(2). The insufficient strength of the existing river-walls for a permanent reservoir.
(3). The danger of forming a large obstruction in the river during the construction of the Barrage, the effects of which no one can certainly predict.
(4). Obstruction to navigation, both during the construction of the Barrage and when it is completed.

The existing admitted inefficiency of the natural drainage of the Thames Valley will be greatly accentuated by the permanent raising of the level of the river, and the cost of installing works for the artificial drainage of the adjacent low-lying lands correspondingly enhanced.

With regard to the existing river walls the question of their efficiency as permanent reservoir walls has not received the serious consideration it merits. Surely this is a question equal in importance to that of the design of the Barrage itself; and any such uncertainty with regard to it, as is indicated, is totally inadmissible. Any engineer who witnessed the effect on these river-walls of the exceptionally high tides of November, 1897, and the manner in which the breaches in them were repaired, will pause before guaranteeing their efficiency for the part they would be called on to

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play in the Barrage scheme. At the present time the vegetation that covers them above the level of high water neap tides is a considerable protection from scour, and this would probably disappear if the level of the water were permanently raised to that of Trinity high water mark as proposed. It would indeed be an appalling disaster if the proposed Barrage proved a second Assuan dam so far as the Thames Valley is concerned.

The process of construction of the Barrage will involve the formation from the start of a permanent obstruction in the form of a coffer dam, which will reduce the sectional area of the river at Gravesend by about one-third. Can anyone predict what will be the effect of this on the rise and fall and rapidity of the tidal flow at and above the site of the Barrage? It is safe to say that it will seriously affect all these; and that the resulting impediments, and danger to navigation with the up and down traffic converging at this point, will drive shipping to other ports, possibly never to return. The danger of interfering with nature's means of keeping the waterways open in a river, where even the shifting of a buoy's mooring has been known to cause the extension of a sandbank, must not be lightly incurred. Those who know most about the action of tides and storms upon the submerged delta in the estuary of the Thames fully recognize this danger, and point out that it would be of little use to provide a channel over 30 feet deep above Gravesend at the risk of the formation of a continuous bar across the channel below the Nore.

The objections to the Barrage scheme so far dealt with are small in comparison with that of the obstruction to navigation resulting from the necessity of passing all the traffic through the locks of the Barrage. The average number of vessels that arrive at Gravesend in 24 hours, going up and down river, is between 600 and 700. It requires no very vivid imagination to picture the inevitable rush of vessels to secure a good billet for passing the locks and the resulting collisions and possible sinkings. For vessels arriving singly or in small numbers in fine weather the circumstances are sufficiently awkward; but mark what will happen on the occurrence of a thick fog of even 24 hours' duration; such fogs are not uncommon, and those of 3 days' duration, during which no large vessel has got under way, are not unknown.

Imagine a fog and from 200 to 300 vessels in the river below Gravesend. The fog suddenly clears and these vessels get under way and make for the Barrage. The tide is at flood and the vessels must swing before entering the locks. The whole width of the river (about 2,000 feet at this point) is full of shipping, and the manœuvre of safely swinging a modern vessel, 400 to 700 feet long, in this narrow channel congested with traffic is inconceivable. A similar situation obtains with regard to the vessels approaching the Barrage from up river. Meanwhile vessels are constantly arriving; these cannot be

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dealt with till those detained by the fog have been got out of the way, and a deadlock eventually occurs. This is no dream of a disordered brain, but the anticipation of those most competent to form a sound opinion as to the probable effects on navigation in the river of a Barrage at Gravesend.

It is admitted that there is no precedent of the dockization of a tidal river of sufficient magnitude to form a guide as to the practicability of dealing with the Thames, and as to how it would affect navigation, tides, river banks, channels, etc. It appears very unlikely that the future of the Port of London will be handed over to the advocates of a scheme which involves so much that is little better than guesswork, more particularly as the scheme has no support from those in the best position to judge of its probable effects.

It remains to consider the Barrage scheme from the Military point of view, and its bearing on the question of possible forms of attack upon the Port and shipping.

The Port of London is not recognized as a Naval base, except possibly in connection with vessels of the torpedo boat and destroyer class; and the defences of the Thames are not armed like those of Portsmouth and Plymouth to meet the organized attack of an enemy's fleet of battleships. It is considered that the established superiority at sea that would enable an enemy to make such an attack would render other measures preferable to risking his battleships in such narrow waters. Furthermore, no British Admiral would contemplate the use of a basin closed by a barrage as a harbour of refuge for a crippled fleet, as the facilities for bottling it up would certainly be taken advantage of by an enterprising enemy. With regard to this Port Arthur is an object lesson.

Accordingly the object of the Thames defences is primarily the protection of shipping in the river, and the keeping open of the trade route for the supply of London. Any obstruction to the free passage of vessels carrying supplies to the Metropolis in time of war will make itself keenly felt in the form of privation and possible famine.

The mere threat of raids by fast lightly-armed vessels upon shipping in the river would no doubt have some effect upon trade; and although there is good reason to hope that we shall maintain our supremacy at sea, the possibility of such raids being undertaken must be provided for.

The Thames defences are designed to deal with such raids; and it is of the very essence of their strength that they should not be concentrated at one point, but extend for some distance along the river, so that hostile vessels may be kept under fire for a prolonged period in case of need and not allowed to run the gauntlet too easily. It is further essential that, when an attack is anticipated (*i.e.*, always on a threat of, and during, hostilities), the whole river area covered by the guns of the fortress should be kept clear of vessels moored or lying at

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anchor; and that, both for the efficiency of the service of the guns and the effective carrying out of the Traffic Regulations, friendly vessels should be passed as rapidly as possible through the defended zone.

It is obvious that a Barrage, constructed in the position proposed, must cause an accumulation of shipping which is incompatible with the efficient working of existing defences, and therefore be most objectionable from a Military point of view. It is not difficult to imagine an enemy's torpedo boats approaching unseen under the shelter of vessels at anchor below the Barrage, and making an attack resulting in the destruction of dock gates and the obstruction of their approaches by means of sunken vessels.

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CAMP TRAINING OF THE OUDH AND ROHILKHAND RAILWAY VOLUNTEERS.

By CAPT. A. GARDINER, R.E.

AN account of the doings in camp of the Oudh and Rohilkhand Railway Volunteers may be of sufficient interest to those of us who are, or have been, connected with the Indian Railway Volunteers to find a corner in our *Journal.* Although such Corps are not at present styled Engineers, the duties which presumably would be theirs in war approximate much more closely to those of Sappers than to those of Riflemen.

The 27th January having been fixed for the annual inspection by the Inspector-General of Volunteers in India, it was decided to concentrate as many members as possible and to form a small camp in Lucknow. This was joined on the morning of the 25th by some 60 men from outstations, making the strength available for the Inspection Parade up to 5 officers (including the Adjutant) and 162 men.

Two parades were held daily on the 25th and 26th. The first three were devoted to drilling the outstationers who, thanks to the good work of the Sergeant Instructors among their little batches of 6 or 7 men here and there along the Railway, quickly dropped into working together; and to practising the "attack" by Companies with ball ammunition on the rifle range.

For the fourth parade practice was carried out with the "armoured train" under the following ideas :—

I. The regular garrison of Lucknow having been mostly withdrawn to the frontier, the country has shown signs of unrest. A large number of former Railway coolies have deserted, and the line has been picqueted by the remaining Regulars and the non-railway Volunteers.

II. Picquets report that 3 rail lengths have been removed from the main line beyond the Bibiapur crossing (about 4 miles from Lucknow). The O.C., O.R.R.V.R., will repair the damage.

The necessary rails of the heaviest section in use on the line, with the full number of sleepers, etc., had previously been loaded into what was doing duty as the "armoured train." Two working parties, each of 16 men and a sergeant, were detailed for the repair, the rest of the battalion forming a train guard and covering party. As there was only a sprinkling of engineers present the working parties had to

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be composed chiefly of Loco. and Traffic men without previous experience of platelaying; no coolies were allowed. The train proceeded to the site of the damage, and the 3 rail lengths were laid parallel to the existing main line and then dismantled and reloaded in readiness for the next day's work.

On the morning of the 27th the Corps proceeded to the rifle ranges for inspection. After the Inspecting Officer had examined each Section minutely on the parts and mechanism of the rifle, the battalion carried out the "attack"; the advance was well executed and the shooting as a whole was good.

In the afternoon the "armoured train" practice was repeated; the style of the laying was a great improvement on that of the day before, the 90 feet of track being laid, straightened and roughly packed in 36 minutes from the time the order was given to drop the flaps of the construction trucks. On this occasion a party was despatched in advance in *tikka garris* to carry out an attack, but failed to get to close quarters until after the "damage" had been repaired.

This is believed to have been the first occasion on which Railway Volunteers have actually laid permanent way in this country. The work was keenly and enthusiastically carried out, and was doubtless a valuable lesson in more than one quarter.

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LANDSCAPE DRAWING FROM A MILITARY POINT OF VIEW.

By Capt. C. E. Vickers, R.E.

We all know that it is useful to be able to draw, and most of us have a foggy sort of notion that on Service a sketch of what a landscape looks like might sometimes be called for to elucidate some particular point. But few of us I think have more than a hazy idea at best of how a sketch of this kind would be utilised. As a matter of fact I do not suppose we ever think of it. Of course it is remunerative to send sketches to the illustrated papers, and a pleasant way of earning pocket money; but that is not exactly a military use for the art of landscape drawing, even if it affords an opportunity of recording the most wonderful (even apocryphal) events.

A sketch of a foreign fortress (to show what the exterior of it looks like, where the guns are, and what the vulnerable points) should be of undoubted value, probably one of the most useful forms which Intelligence about such a place can take; but I should imagine this is not a task to be postponed until War is actually in progress. How then are we to employ our drawing talents so as to be of most service to our country?

I am sure many brother officers have theories on the subject. It seems a very suitable matter for discussion in our Journal; and I would humbly suggest that any officers who have views to state should take an opportunity of putting them into print for the benefit of others.

Arising out of this question, information as to the best methods of reproducing drawings in the field would be most useful.

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TRANSLATIONS.

FORTRESS WARFARE AS ILLUSTRATED BY THE FIGHTING ROUND PORT ARTHUR.*

(*By* Lieut.-Colonel Frobenius *in the* Militär-Wochenblatt, 13*th and* 15*th October*, 1904).

I.—The Rôle of Fortresses and their Garrisons.

The science of fortress warfare does not derive much benefit from the blessings of long-continued peace. The lessons deducible from peace training being of very small value, its only progress is dependent on theoretical investigations and literary discussions. It is handicapped more than other military sciences, as these derive instruction from the organisation and the employment of living beings, from the records of technical improvements and of practical trials. On the other hand it is rarely possible, owing to the expense entailed, to endow inert fortifications with life and colour by means of fortress exercises; and when such are undertaken, it is usually on so small a scale and in so hurried a manner that wrong impressions are conveyed and wrong deductions too easily drawn.

As fortress warfare will undoubtedly play an important part in a future European War, the extremely instructive conflict of two modern armies for the fortress of Port Arthur affords a welcome example. We need not hesitate to use it for testing our previous theoretical views and for modifying our ideas. It is true that our information is still too sketchy to apply it to details, both as to tactical and technical matters; such investigation must stand over until a later period. This is, however, not the principal question for the Army at large, but merely a speciality for some of its branches. We are already in a position to review *on broad lines* the doings of both the attacker and the defender; we can judge of the character and the general progress of events, of the assistance afforded by fortifications prepared and located in peace time, and also of the importance of the fortress as such to friend and foe in their respective plans of campaign and in the progress of the war. This seems to me a sufficient basis for amending our views concerning the value of fortifications, their powers of resistance against modern weapons, and the method of their employment.

The second Japanese Army, after landing at Takushan and Pitsevo, turned in May towards the South of Liaotung and toward the Kwantung

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Peninsula. The opinion was then freely expressed that this army would make a great mistake if it allowed itself to be attracted by Port Arthur, and if it laid siege to that fortress. It was a principle derived from 1870 to take the field army past fortresses in order to obtain a decisive result with concentrated forces against the hostile armies. Entirely isolated, it was thought that Port Arthur would fall an easy victim. This view, backed by many influential authorities in the army, had much to recommend it; it was based on the conviction that the Japanese Fleet had secured the mastery at sea, and was free from further aggression by the enemy. I am not sure whether our comrades in the navy were of the same opinion.

The importance of Port Arthur was first of all due to its being a fortified harbour and, for the Russian fleet in the theatre of war, the only base which, owing to freedom from ice, was available all the year round. Men-of-war shut up there were not rendered entirely innocuous; their offensive power could not by any means be thus ignored; and the Japanese Fleet by itself was not powerful enough to divide its forces and to cripple this adversary, while at the same time fulfilling all its other tasks, such as affording protection against the fleet at Vladivostok. It must not be forgotten that Japan was engaged in a transmarine campaign, that any doubt about her supremacy at sea was equivalent to danger to a most sensitive line of communication and to risking the very existence and liberty of action of the entire field army. At that time too the army's base of operations on the mainland was a very precarious one. The nature of the southern coast of Liaotung and of the western coast of Korea makes the landing of large bodies of troops and of war material as difficult and slow an operation as transport along the Russian single-line railway. Taking the lack of roads in that part of the country also into consideration, it cannot be disputed that bases situated in those districts were very risky. Only two bases could be considered satisfactory, viz. :—Dalny and Newchwang (or rather its port Ying-tse).

In order to safeguard all operations against interference from Port Arthur, it would only have been necessary to cut off the Kwantung Peninsula, for which purpose the neck at Kin-chou afforded ideal opportunities. A strongly fortified position on the hill at Nanshan could have been held by a comparatively small force, and this line of action was advocated by those who considered the siege of Port Arthur to be a mistake. But this hill was occupied by the Russians, it had first to be captured by a desperate fight, after which Dalny fell into Japanese hands without further effort. The subsequent employment of Dalny as a base was so much to the latter's advantage that they could not well help grasping the opportunity and taking steps to safeguard it. Such steps could only consist either in extensive defences of the port against Russian aggression, or in an attack on Port Arthur itself. They should not be blamed for their choice of the latter alternative, especially as the capture of the fortress would destroy all Russian hopes of the fleet contained therein, after having been refitted and reinforced from home, again threatening Japanese supremacy at sea and thus endangering the issue of the war. That this fortress would be able to offer such dogged resistance,

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that its siege would engage so large a proportion of their forces, was certainly never expected by the Japanese who had their experience of 1894 as precedent.

Probably politics and ambition were also factors in determining them to attack the fortress. Port Arthur, next to Korea, was the chief objective of the war; the possession of the harbour, as important for Japan as for Russia, will infallibly be demanded as a prize of victory; and it was excusable for the Japanese to consider it a point of honour to take this fortress, which they were deprived of by foreign interference when they captured it before. It would nevertheless have been a mistake, for such reasons, to dangerously weaken their field army before an issue had been reached in the field, unless the reasons previously mentioned had been imperative. To the Japanese, however, it did not seem so serious a matter to detach a siege army as it did to their European critics, for they knew very well that they had at least twice as many troops as was supposed by Russia. This may have rendered the decision more easy; and their calculations promised that, even after detaching several Divisions, they would continually be able to reinforce their army faster than the enemy could his, and that they would thus be able to retain numerical superiority for a long time to come. Facts have borne out this calculation.

It was considered sound in Germany, as recently as 10 years ago, to deduce from the experience of 1870-1 that an invading army could only be compelled to capture such fortresses as lay directly along its lines of operation and which could thus cut off and endanger its communications, while more distant fortresses were not worthy of attention. Port Arthur has furnished a contrary example, to the effect that there may often be other weighty reasons for attacking a fortress than merely its immediate influence on the lines of communication of the field Army.

Port Arthur had two duties to perform. Its fortifications were intended to enable it to act as a base whence the fleet could undertake offensive operations. To effect this, hostile ships must be kept at such a distance off a harbour entrance, and away from its outer anchorage, that its own ships can issue and form up in the open without danger or molestation, and that they can escape pursuit when forced to retire. If this object is attained a port and its equipment are *ipso facto* safe from bombardment. Fortifications must also close and protect the entrance against a raid. The coast defences of Port Arthur perfectly fulfilled all these requirements. The inability of the Japanese fleet to vanquish them unaided, or even to permanently restrict the liberty of action of the enclosed war vessels, has been decisively proved. This fleet was restricted to a blockade, to the task of protecting the transport of troops, arms and stores for the besieging army, to securing the army's shore flanks, to preventing supplies and information reaching the fortress, and to stopping the interned fleet from acting at sea.

The capture of the fortress—even of its coast defences—therefore entailed an attack by land, and such attack has to be resisted by the main army, unless the latter are relieved of this duty by defences on the land front. Besides protecting a port from inland bombardment, land

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defences are relied upon to relieve the field army of the care for this point of strategic importance, to attract as many hostile forces as possible, and thus to withdraw them from decisive action in the field. This is an old, a well-known principle; but its correctness depends on the faith that the fortress will be able to repulse, unaided, all hostile attacks.

In this connection it is imperative first to settle the question whether up-to-date means of attack are able to overcome in a comparatively short time the resistance of an efficient garrison holding a modern fortress fully equipped with all accessories. If any doubt were justified, the responsibility for such a fortress would form a constant source of pre-occupation to the Commander-in-Chief, and it might thus unfavourably influence the operations of the Army. *The value of a fortress thus depends on the confidence in its efficiency.* As this cannot be founded on theoretical reasoning, on calculations, or on examples from ancient history, but only on up-to-date instances of successful resistance, the facts of the fight for Port Arthur, pursued on both sides with unequalled energy, endurance and sacrifice, become of primary importance in rightly estimating the value of fortresses. The justification for their existence is established, a right which would have been very doubtful had there not been clear proof of their power of affording lasting resistance.

The vital question of fortresses thus favourably answered, the progress of the attack and the defence affords further valuable lessons for elucidating a number of important questions for fortress warfare in a far more convincing manner than can be done by theoretical reasoning.

1. *The employment of the general reserve in the distant forefront.* Ever since the adoption of the principle of considerably strengthening the defensive garrison of a large fortress by the addition of a large body of troops, similar in composition to detachments of the field army, to act as a general reserve, proposals have been formulated for the employment of this body in front of the fortress. Two opposite views have appeared in this connection. One of these is defined in the French Regulations, entitled *Instruction générale sur la guerre de siège* (1899), and recommends the extension of the offensive enterprises by the general reserve—even augmented by positions of the defensive garrison—to such an extent that the attacker be met, his advanced guards assailed and his flanks threatened, in fact, that he be made to suffer as much as possible by aggressive action. The other view, chiefly represented in Germany and Austria, deprecates the employment of shock tactics under all circumstances; but wishes the general reserve always to adopt fire tactics, while confining its activity, when far out, to the occupation of such positions as must be assaulted by the attacker and cannot be evaded in his effort to reach the main line of outer forts with a siege train. Even in such positions obstinate resistance should be avoided, and retreat should be effected as soon as it is obvious that the enemy has developed sufficient forces to ensure his early success. Under all circumstances the delay of the attack should only be aimed at, while large losses, inseparable from offensive action or an obstinate defence, should be avoided.

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It is interesting to note that the Russian General Kasbek, in his guide for the attack and defence of fortresses, writes in favour of the first-mentioned view of shock tactics:—"With a view to delaying the investment by an adversary, all the garrison, with the exception of troops absolutely essential for repelling a surprise assault, should be sent out to meet the enemy in the open, where it should endeavour, both by manœuvring and by fighting, to beat his advanced troops and to threaten his flanks, taking care however not to expose itself to any risk of being cut off from the fortress." Which measure did General Stoessel adopt? and how did it turn out?

The garrison of Port Arthur consisted, as far as we know, of the 4th and 7th Divisions of East Siberian Rifles (24 battalions), with their Brigades of Artillery of unknown strength, three Battalions of Fortress Artillery, and one Company of each of the following, viz.:—Fortress Sappers, Miners, and Telegraphists; a total force amounting to about 40,000 men. It is reported that amongst the killed, left behind on the Nansan Hill on the 26th May, men belonging to seven different regiments were found, from which fact it would appear that Stoessel had detailed troops from each of his eight infantry regiments to form the general reserve, a disruption of units for which there may have been special reasons. It may certainly be assumed that at least seven battalions occupied the position referred to, and it is indeed probable that there were no less than twelve. The position was about 27 miles from the forts of Port Arthur, but this space could be bridged by the connecting railway, and trains were kept in readiness at the station of Nansan-shi-li-pu for the transport of troops in case of need. The position had been prepared a long time beforehand; shelter trenches had been constructed, with numerous bomb-proof covers, and in several lines in tiers behind one another, in front of which obstacles and mines had been arranged. Special assistance was afforded by a number of old, but useful, Chinese fortress guns of small and medium bores (numbering 68 according to Japanese accounts), besides some machine guns. Field Artillery does not appear to have been strongly represented, only two batteries being mentioned.

With both flanks resting on the seashore, the position was about 2 miles long (the Talienwan Peninsula being excepted) and about 525 feet above sea level. The position could not be avoided by land, but it was possible to outflank it on both sides by utilising the shallow foreshore, which at low water was high and dry in parts. In order to make this position practically impregnable it would have been necessary for the fleet to act in support on both wings. Such support could however no longer be counted upon in view of the loss of the command of the sea, and it must be considered a stroke of luck that a Russian gunboat and two destroyers succeeded in evading the Japanese cruisers and reaching the Bay of Talienwan, where, despite hostile artillery fire, they managed to take an active part in the battle. Probably it is their assistance that caused the failure of the attack of the 3rd Japanese Division against the Russian right. Similarly it was the employment of the Bay of Kin-chou by the Japanese Fleet that enabled the Russian left to be outflanked, the

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enfilade fire of the ships' guns making the position absolutely untenable; in this case three gunboats and an armoured coast defence vessel (with guns corresponding to two 8·4″, two 6″, eight 4·8″, one 3″ and five 1·85″) were employed as far as the depth of water and their respective draught permitted; it was fatal to the Russians that, just in the evening, the rising flood enabled these ships to again approach after having been compelled to withdraw in the middle of the day, their assistance thus coinciding with the last enveloping attack of the 4th Japanese Division.

The position at Kin-chou was an instance, which is rarely likely to recur, of providing means for closing the enemy's only avenue of approach to the fortress. Its distance, rather more than one day's march from the defences, was not of sufficient importance to prevent its being made use of for delaying the hostile advance. The Commander of Port Arthur had to reckon with the possibility of the Japanese landing at Pitsevo, a coast line, which, though rather unfavourable, they were well acquainted with from 1894; thence they would have been able to advance across the peninsula, cutting the railway while approaching Port Arthur. This they might have done, not so much with a view to attacking the fortress as to preventing its garrison from interfering with their operations. The Japanese could most easily have effected this by occupying the position at Kin-chou. The shores of Liaotung were watched by small detachments of the field army, who seem to have been supported by somewhat stronger forces on the heights behind them. Takushan (2,400 feet), 4 miles to the east of Kin-chou, was thus occupied. General Stoessel was therefore able to join his mobile forces with this detachment and to make an offensive advance, in accordance with General Kasbek's instructions, against the enemy's flanks, whether advancing in a westerly direction on Port Adams or along the eastern coast on Talienwan. To effect this, it was possible that a successful action would first have to be fought. Such success would not, however, have been of any considerable importance, as the main body of the field army was too distant to turn it to good account; while Stoessel could only have secured it at a loss, which could not have been replaced, at the same time exposing himself to the risk, if not successful, of being cut off from the fortress as he was dependent on a defile for his communications. It would therefore have been a mistake to do the work of the field army, while relegating the functions of the fortress and its garrison to a secondary position.

It has sometimes been assumed that the battle of Takushan on the 17th of May was fought by parts of the garrison. This seems to me impossible, as the Russians engaged here retired towards the north. Should it, however, prove to have been the case, the issue of this battle would merely prove such employment of the garrison to have been mistaken, as the troops engaged were actually cut off from the fortress. By confining himself to the defence of the Nanshan position, by sending forward his firing resistance—even the employment of spare fortress guns being in this case justified—Stoessel achieved more, he attained everything that was feasible under the circumstances; he compelled his adversary to capture at an enormous sacrifice the position, which was an indispensable one, and he probably delayed the advance and the commencement of the

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siege very considerably. As he managed to retire in good time, his own losses were not excessive in view of the result obtained. Nevertheless so extensive an advance of the general reserve must not be laid down as a type for the future. Circumstances required it in this case, but such circumstances are not likely to recur. The defence of Kin-chou must therefore be considered to be an exceptional case. The normal employment of the general reserve did not commence till the 26th May.

II.—Defence of the Foreground.

The peninsula of Kwan-tung has in front of the railway station of Nansan-shi-li-pu, upon which General Stoessel had retired, a position affording protection to Victoria Bay and to Dalny. But the right wing would have had to extend as far as Point Robinson, as the narrow bay to the north of this (Junk Bay) is so shallow that it could not be relied upon as a point of support for the flank. The General had just had experience that shallow sea waters afforded no protection; he could scarcely rely any longer on the support of his own fleet; he had rather to fear that Japanese ships would threaten in rear and in flank the peninsula ending at Point Robinson, and thus make the position untenable. Situated at a distance of 21 miles from the outer forts, and exposing him to the danger of being forced off the railway running along the north shore and of being cut off from the fortress, this position was too risky a one, and Stoessel therefore gave up the idea of holding it; his forces would probably hardly have sufficed for its occupation. He retired as far as the Lung-wang-ho which flows into the sea about 6 miles from the forts. The breadth of the peninsula at this point, as far as Ingentsi Bay, is about 10 miles, and it would seem that the formidable Mount Trible (Jupilatsu) situated some distance from the north coast, as well as the heights on both sides of the Lung-wang-ho, afford a good position.

We are almost entirely without news as to what happened between the 26th May and the 26th June, on which latter date the advance of the Japanese against this position started. We do not know whether there was any fighting whatsoever in the broad tracts they had to traverse after the 26th May. It appears, however, that they contented themselves with the occupation of Dalny, protecting themselves in this position just in front of the railway. They devoted all their energies to getting the harbour of Dalny into working order and to preparing means for carrying on a siege. In the subsequent fighting they had heavy guns at their disposal, whereas at the attack on the Nansan position they had not even field howitzers. During this period also the army of Oku was probably relieved by the divisions of General Nogi; but we are not fully informed as to when and how the general relief was effected. General Stoessel estimates the strength of the Japanese at the battles on the Lung-wang-ho as being five divisions. It is fairly safe to assume that at any rate by the beginning of August the 5th, 6th, 9th and 11th Divisions, besides the 5th and 11th Reserve Brigades, also possibly the 6th and 9th, were in front of Port Arthur; in September the 8th Division is said to have been added to these.

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It is certain that at the end of June the Russians were forced to retire from the left to the right bank of the Lung-wang-ho on account of their left wing having been outflanked, but they recaptured the left bank in the first week of July and retained it until the end of the month. The Japanese were compelled to bring heavy (6-inch) guns to bear upon this position, besides calling in the fleet to their aid. After heavy artillery preparation the attack was commenced on the 26th July, and was continued uninterrupted for three days, but without success. The Russian cruisers and gunboats also took part in the battle and with good success, the Japanese, owing to the danger from mines, no longer employing their modern ships in the vicinity of the coast. At the same time an attack on the position of the Jupilatsu was carried out with equal lack of success. The situation remained unchanged until the 30th July, when the Japanese succeeded, by employing their whole blockading fleet, in preventing the Russian Navy from taking part in the battle. By means of a combined attack of five divisions, supported by siege guns and by four battleships, four large and ten small cruisers, and 48 torpedo boats, Stoessel was finally forced to evacuate his position and to withdraw into another one immediately in rear, which extended along the declivity of the Takhe and rested to the north on Wolf Hill. As this position undoubtedly extended as far as Louisa Bay, its total length was about 10 miles and it exceeded the powers of the garrison to occupy it with sufficient strength throughout. Thus it appears that as early as 30th July Wolf Hill had to be evacuated on the approach of the enemy.*

The capture of Wolf Hill constituted a considerable success for the attacker, because he thereby captured the principal artillery positions necessary for fighting the forts. Its distance from the north front of the line of forts (Kikwan and Rikwan) is about 3 miles and from the port itself 6 miles, so that it was possible to reach the latter, including the war vessels therein, with the long 6-inch gun. It is reported that on the 6th August 20 heavy guns were placed in position here, and the statement that both the town and the harbour were being hit removes all doubt about these guns having been made use of. The subsequent fights (often inaccurately described in newspaper accounts as assaults on the line of forts) aimed at driving back the defenders from the advanced positions which it was necessary to take for artillery purposes. Therefore the position on the Takhe (Takushan and Shakushan), in front of the eastern forts, became the first objective. Takushan, captured on the 8th August and recaptured by the Russians on the 9th, appears to have been obstinately defended until the 14th. Similarly (on the 15th and 16th) determined attacks were made on High Hill and Division Hill in the neighbourhood of Louisa Bay, and according to Stoessel's account these attacks were repulsed. Subsequent fights between the 17th and 20th of August appear to have placed the Japanese in possession of foreground to a sufficient extent to enable them to occupy artillery positions enveloping the north front and the northern portion of the east front. If even after this date the Russians had not entirely relinquished the foreground, it may nevertheless be considered that at this period the fights for the foreground ended.

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These eight weeks of obstinate fighting on the part of the general reserve, which we have estimated as being only equal to a division, against vastly superior forces, have provided us with a proof of the possibility of defending the foreground, a matter which has often been considered doubtful. They tend to show that the best method does not consist in delivering a number of independent offensive blows, but in gradually retreating from one carefully prepared position to another. They have proved that an attacker, even when having at his disposal such fanatical and reckless troops as General Nogi, will find it impossible to run through an efficient garrison holding a carefully entrenched position. It will on the contrary require much time and trouble to prepare sufficiently powerful measures to compel the defender to retire. It required, as it would appear, the preparation of complete positions on the opposite side to obtain a secure base for the attack, and the defender's fire effect was such that these positions had to be constructed during the night. On the other hand the weaknesses of defensive positions in the foreground are also shown up. They consist chiefly in the fact that they do not surround the fortress in a continuous ring and that equally favourable conditions of ground are not to be found everywhere. The conditions in the case of Port Arthur appear exceptionally favourable, because only a portion of the circumference could be utilised either by friend or by foe, the major portion being sea bound and secure against operations on land. But even this segment of a circle compelled the defence to occupy broken positions, which, split up by intervals, made control difficult and offered many vulnerable points in the numerous exposed flanks. The positions when outflanked had always to be evacuated. Therefore the rule applies to these positions as it did to that at Kinchou, that they should never be held to the last, but should be evacuated as soon as the attacker has been compelled to bring up sufficiently powerful means for their capture. That this alone means a good gain is proved by the fights round Por Arthur. The duty performed by the heavy artillery is merely an accessory one; the main duty devolves on the infantry, which has to handle the spade as well as the rifle.

III.—The Fight for the Line of Forts.

The view has often been held that infantry must certainly solve the problem of driving back the defender from the foreground so that heavy artillery can be brought into play; but that at this point its duty ends, as everything else could be confidently entrusted to the heavy arm, which would quickly gain a preponderance over the artillery in the fortress. This was generally, but without cause, imagined to consist in the complete destruction of the fortress artillery; and it was thought that the guns would then drive the defenders out of their defences by shattering their nerves, so that the infantry, after such careful preparation, would merely be required to pluck the ripe fruit without any trouble. As soon as the heavy artillery opened fire, it was expected that the infantry would have a period of spectatorship, probably of short duration, while the success of the artillery action was being awaited. "When the

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artillery of the defender is in the main part silenced, when his infantry has retired behind the line of forts, and when pickets and reconnoitring parties sent out from the artillery position are little interfered with by the defenders, then the time for an infantry attack has come." (*Feldtaschenbuch fur officiere des Geniestabes und der Pioniertruppe*, published in 1902).

Others go further than this and think that a short but extremely sharp bombardment, concentrated solely on the forts as pivots of the position, would suffice to overcome the garrison and would enable an advance in large masses to be made against the line of forts with every chance of this line being broken through. The example of Kars, given by the Russians, proves that a successful piercing of the line can lead to the fortress being captured, if the latter is without an inner line of defence and if the troops driven back from the line of forts have no opportunity of finding cover for renewing the resistance. Port Arthur as far as we know lacked a town parapet. The ground is not suited to one, and it would only be a question of defending the hill between the old and the new cities. The occupation of this hill would not prevent the attacker from placing the town and port under concentrated direct fire from the surrounding hills, which afford so excellent a position for the line of forts. The fate of the fortress and of the fleet would therefore probably be settled as soon as the line of forts was pierced.

Whether the main line of defence at the forts satisfied all modern requirements of defensive works is uncertain, but it appears open to doubt in more than one respect. We have only certain information about the Chinese fortifications built as a temporary measure and captured by the Japanese in 1894. The Eastern portion stretched from Cape Laolishui to the gorge of the Lunche Valley, along the heights of the Drakonnowji hills, a distance of about 5 miles, having in front of it the broad open valley of the Takhe. Of the three main forts one was situated on the east front, Kikwanshan on the short north front, and Erhlungshan on the junction of the north and east fronts; nine smaller independent forts, besides connecting lines, completed the position. This line was no doubt kept by the Russians, though it was probably improved and a large number of additional works appear to have been constructed. To the west of the Lunche the Chinese had fortified the Isusan Group, which is somewhat to the rear of the eastern portion of the north front; and here we have the Itseshan fort and several subsidiary works. This group is commanded by the surrounding heights, and it is due to this that the entry of the Japanese at this point was favoured in 1894. The information appears correct that the Russians pushed forward a new position on to these commanding heights and connected it with the western line extending along the heights of Sanshan to White Wolf Hill, where they reach the coast. In order to remedy the lack of drinking water they constructed reservoirs and wells south of the village of the Shui-shi-jin and they led the water thence into the town. To protect these waterworks, which extend well beyond the main line of forts, a fort (Kuropatkin) is said to have been constructed, which was probably south of this village on the rising ground to the west of Palitshwang. The total length of the whole defensive position would be about 12 miles.

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As to the nature of the fortifications all information is wanting, as the Russians maintained absolute silence on that point and the reconnaissance of Russian fortresses by Europeans is well known to meet with insurmountable obstacles. The Japanese were probably better informed owing to their excellent intelligence system. From statements made it would appear that the Russians, true to the principles they have followed in other fortifications, made somewhat different arrangements from those we are accustomed to find with other European nations. A thorough separation of the positions prepared for distant fighting and for close fighting does not appear to have been carried out; that is to say, the artillery was not restricted to occupying the intervals and the ground outside, but was also introduced into the forts. Protection in this exposed position by means of armoured towers, which we consider essential for retaining permanent fighting power for our artillery, was not provided; however, it is not improbable that the same object was effected by providing disappearing carriages and perhaps also by fitting gun shields. It is also not impossible that a conventional preference for bayonet fighting and for counter-attack by the internal reserve caused too little stress to be laid upon the provision of a permanent, assault-proof, thoroughly-flanked obstacle; and that, instead of it, frontal fire on to ditches filled with field obstacles was arranged, with a view to facilitating such counter-attack.

If we may therefore doubt the Russian works, as regards their power of resistance, being fully up to requirements, it is perhaps also questionable whether the preparation for the artillery defence reached even approximately the perfection aimed at with us. As regards the construction of a circular road and the necessary communications with the town, nothing is known; the considerable differences of level, and the intersected nature of the ground make such constructions very difficult. The well-known preference for developing the construction of Dalny probably caused Port Arthur to be stinted of the necessary funds; and to make up for lost time during the war itself was impossible owing to lack of men. Whether the material necessary for narrow gauge railways was at hand is very doubtful. Whether means were provided to construct artillery buildings in the intervals between the forts, besides those constructed in the forts themselves, is also open to doubt. It may therefore be assumed that Port Arthur was not qualified to produce the highest results possible, and consequently our great forts ought at least to be able to render as good an account of themselves, assuming the commander of the garrison to be equally good.

How did the Japanese proceed in the method of their attack? Do their successes justify the views expressed above? The impatient nature of the Japanese, the importance which they attributed to the speedy capture of this fortress and to the destruction of the Russian fleet, led one to expect that they would carefully prepare the attack as they do their field battles, and that they would not unduly hurry themselves in doing so, but that afterwards they would not await the success of the artillery fight with infantry inactive. It was therefore not surprising that a violent attack immediately succeeded the period of fights for the artillery

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positions. On the 6th August the first heavy batteries had been got into position on Wolf Hill; until the 20th fights took place for the artillery positions, and on the very same day commenced a period of practically uninterrupted violent attacks and attempts at penetration. It may be supposed that the batteries first constructed had already operated for some considerable time on the northern forts and that the Japanese counted on these being shattered. The tremendous fights lasting for ten days, the losses numbering many thousands, the co-operation between a powerful artillery and greatly superior numbers of fanatical troops filled with a wild hate and a contempt of death, effected no more than to prove the great power of resistance possessed by a fortified position prepared in peace time, a power which has so often been disputed. The Japanese, who had effected an entry into the defensive line more than once, had to retire, and they could only retain one point in the vicinity (Pulingshing). When some final attempts in the last days of September had also failed, the attacker resigned himself to the necessity of letting the artillery play for a prolonged period prior to his making a repetition of these violent assaults.

From some newspaper articles, however, it would appear that the Japanese infantry did not remain idle. From the investing position, situated about 2½ miles from the line of forts, the infantry advanced with the aid of earth works, and it is even reported that they attempted to approach the forts by means of mining, in order to blow the forts up. They discontinued this, however, probably because the technical troops had been insufficiently trained for such work and were not able to overcome the difficulties due to the rocky nature of the ground. The situation of their investing position would seem to confirm my view that the danger from the fire of fortress artillery should not be exaggerated, and it is therefore not necessary to remain at a very great distance from the works.

While the attack was making progress, the artillery is said to have been reinforced by mortars. It is, however, doubtful whether a weapon of the nature of our 21 cm. (about 8¼-inch) rifled mortar is meant thereby, for I have it on good authority that the Japanese did not receive steel blocks for the manufacture of such mortars from Krupp, and it is well known that they purchased all the raw materials for their siege artillery from this factory. The employment of such mortars would therefore only be imaginable if they had succeeded in manufacturing them entirely in Japan, but in that case I should be inclined to doubt their efficiency. The artillery action is said to have been weakly pushed by the attacker, and is even said to have been interrupted during long periods, which seems to point to a lack of ammunition. This assumption must not be considered far fetched, because the transport from Dalny had to be carried out over a country road about 18 miles in length, and these roads are stated to be hardly practicable during periods of rain. The railway could not serve this purpose, as the Russians had succeeded in securing all rolling stock. It was not until the capture of Liaojang that railway trucks fell into Japanese hands; and even these, owing to a lack of locomotives, had to be propelled by manual labour. As these trucks were no doubt principally used for the field army, the transport of ammunition for the guns in

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front of Port Arthur was probably a more serious matter even than ours before Paris.

A second period of assaults, which opened with a heavy bombardment on the 15th September, is said to have commenced on the 16th, and to have led to the capture on the 21st of some important forts, Kuropatkin and Itshwan; but the report has not been confirmed. On the contrary it is now reported that an order has been issued from Tokio to the besieging army to abstain for the present from further assaults. This would mean that the attacker realises the necessity of proceeding with a leisurely and deliberate siege. A greater triumph could not be celebrated by the fortress.

Nevertheless the fortress will not be able to maintain itself when its forces and resources become exhausted, and it does not seem improbable that after sufficient preparation a violent assault undertaken from closer proximity will end the situation before that period. As soon as the Japanese succeed in capturing a portion of the line of forts, then will Port Arthur, owing to its lack of a second and interior defensive position, be unable to offer further resistance. But it has nobly done its duty, and it has proved the power of resistance of a modern fortress. Great credit is due to the Commander, who knew how to dispose of his forces in so efficient and thorough a manner, and how to imbue his troops with such enthusiasm that they offered this heroic resistance in fights of unexampled fury and of enormous strain.

Since the Turkish war no fortress has been attacked with such fury, and so regardless of the heaviest losses in men. Never has a fortress been tested as to its power of resistance by such a series of almost uninterrupted assaults. If this fortress, the value of which is open to doubt in more than one respect, could, in the hands of a courageous and efficient commander, withstand such an attack so long and so successfully, we may place the greatest confidence in our fortresses which are better equipped; we may rest assured of their power of doing all that is required of them, and of offering a long-continued resistance against any weapon of offence.

IV.—Mines.

When in 1889 our pioneer troops were organised as pioneers pure and simple (in fact hardly as more than pontoon troops) the miner vanished from the German Army, and with him naturally vanished all interest in the further development of mining and the sciences connected therewith. In other countries this science has made considerable progress, which has been practically ignored by us. The Russian Army especially has developed this service considerably. It was therefore to be expected that the employment of mines would be noticed in the war in the Far East, though it seems unlikely that Port Arthur had already been provided with a regular system of mines like other Russian fortresses. General Stoessel ordered the construction of mines in front of the position on the Nanshan Hill as obstacles, that is to say of so-called trip mines, which generally are not considered of much value, owing to the usual experience of their not going off at the right moment, so that their actual success did

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not justify the fear with which they were viewed. The effect in the most favourable circumstances was a moral effect. Their reputation was not increased by the experiences which the French had in 1870 at Paris with their mines in front of the fortress, and which so often failed to act. It need not therefore be considered exceptionally lucky for the Japanese to have discovered on the 26th May, before the ignition of the mines, the connecting wires in front of the Nanshan position, when they were able, by disconnecting them, to avert all danger.

In front of Port Arthur, however, such mines seem to have played a more important part. They are said to have rendered the occupation of the Wolf Hills most difficult. On the 26th and 27th August they are supposed to have inflicted considerable losses on the Japanese in their assaults on the subsidiary defences, and on the 3rd September they are even supposed to have stopped an attack altogether. And as General Stoessel himself, in a report of the 2nd of September, lays stress on the effect of automatic mines on a hostile column, it would appear that the report emanating from the opposite side was not without foundation; the report stated that the Russians constructed mines in the valley between Long Hill and Division Hill before they evacuated that portion of the country, mines extending over a distance of nearly a mile and concealed by means of rocks and earth. It is stated that when, during the night of the 3rd September, an advancing column was discovered in this valley by means of search lights, the garrison fired these mines electrically; and the explosion, which actually threw stones into the Russian positions, almost annihilated the hostile column. Even if this report is considerably exaggerated, there would still appear to be sufficient justification for paying greater attention to the employment of automatic and of observation mines, and it is not unlikely that the Russians succeeded in getting much more value out of them than had ever previously been possible.

Whereas the defenders were enabled to make considerable use of, and to derive considerable advantage from, their peace training in the science of mining, and to make the attacker fear these mines so much that he wished to employ similar mines himself, the Japanese evidently could not carry out this intention as their technical troops were trained entirely according to the Prussian example and were therefore unable to carry out the technical works required. Here is a lesson which should be well considered, that it is undesirable to neglect entirely a branch of technical training which may possibly at some future time be of great value to us against our western neighbour.

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REVIEWS.

THE CROSSBOW.

Its Construction, History and Management, with a Treatise on the Balista and Catapult of the Antients.

(*Continued from March Number*).

A review of Sir R. Payne-Gallwey's colossal work would not be complete without a reference to the mechanism, range and sporting use of the weapons so fully described. The influence of the mechanism on the flight in relation to the ranges obtained, the results of some hundreds of years of experiments as bearing on present-day projectiles, is instructive to all who are at present engaged in thinking out possible secret improvements to existing armaments.

As already described, the longbow was the cherished weapon of the English people in the 14th and 15th centuries, whilst the crossbow held a similar position in France, Germany, Italy and Spain.

The longbow was but a hewn stick of foreign yew, bent to shape and of little intrinsic value; but the crossbow gave the artist, the engraver, the inlayer and the mechanic great chances of exercising their talents. Many of the mediæval crossbows still to be seen in foreign museums are beautifully constructed weapons, and in nicety of finish compare favourably with a costly modern fowling piece.

The mechanism of the primitive crossbow was very simple; a straight piece of wood, rectangular in section, formed the stock, the arrow bolt resting in a groove on the upper side of the stock. The near end of the groove was fitted with a catch, over which the cord, or bowstring, was stretched. At right angles to the stock was the bent bow. To stretch the string the whole power of a man was required; standing with his two feet on the bow, one foot on each side of the stock, whilst at the same time grasping the cord with his hands, he slowly bent it back over the catch. A stirrup of iron fixed to the middle of the bow, to place one foot in whilst stretching the string, formed the next modification. But this primitive form of weapon was soon in turn superseded by a bow, which, instead of being made from a single solid piece of wood, was compositely built up of horn, whalebone, yew and tendon, thus helping to prevent the warping or setting to which the solid bow was liable.

The composite form of bow is said to have been introduced into Europe during the stirring times of the Crusades by the Saracens from

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the East, that useful article, best town-made glue, appearing for the first time in recorded history. This built-up form of bow survived in Northern Europe till about 1460, although in France, Spain and Italy a superior crossbow, consisting of a thick steel bow and windlass, had already been in use for nearly one hundred years.

The composite bow was attached to its stock by means of a bridle made of sinews, acting as a spring buffer in lessening the jar to the stock caused by the rebound of the bow after a discharge; indeed, in crossbows now 300 years old, with sinew bridles, it has been found impossible in experiment to knock the bows from out the stocks, even by the use of a heavy hammer, without first cutting through the bridle, so firm and hard had the sinew become through the action of dryness and age.

The mechanism connected with the releasing catch, over which the bowstring was stretched in mediæval crossbows, consisted of a trigger, actuating a detent, a spring, a revolving nut and lock. In the earlier crossbows the lock-pins were riveted in by a hammer, but after the 15th century we find that steel screw pins with split heads were used for the purpose.

The next advance in construction is the use of steel bows, the ends of the bow being slightly canted up from the centre in order to relieve the grooved edge of the stock from being unduly pressed by the bowstring, thus lessening friction.

In order to draw the bowstring of a powerful steel bow to the nut or catch, a windlass or, as it was called later on in the 16th century by the French, a cranequin, was now introduced; this was detachable, fitting on to the stock. By the aid of two revolving windlass arms and a pulley the cord, or string, was gradually drawn back to the catch; this method supplanted the older one of drawing back the bowstring by hand or by means of a metal claw hanging from the belt surcingling the jerkin of the man-at-arms, who at the same time held an arrow bolt between his clenched teeth ready to place in the groove of the stock when his bow was bent with tautened bowstring up to the catch.

The arranging of the arrow bolt, or quarrel, as it was termed, had to be made with great care, so as to reduce friction to a minimum and secure accuracy of flight; the usual length of the bolt was 12½ inches, head 3 inches, the butt of the shaft being tapered, with flattened sides of elliptical section; the weight of the metal head was 1½ oz., shaft 1 oz., the head being of greater width than height, so as not to touch the groove of the stock when in flight. Great niceties of adjustment were required with regard to the position of the three feathers on the arrow shaft, the inclination of the head of bolt, and the position of the releasing nut's face, in order to secure uniformity of range and accuracy of aim.

In some cases the feathers were inserted spirally on the arrow bolt, whilst in other cases grooved flanges were cut longitudinally out of the shaft, taking the place of feathers, and were found to be very effective in causing the arrows to fly with greater accuracy and force.

By the first quarter of the 16th century barrels of metal, doubtless suggested by the hand-gun, or arquebus, were fixed to the stocks of the crossbows, the barrel having to be cut away to allow the bowstring to

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slide along the stock. Crossbows fitted with barrels were termed slur-bows; they discharged bolts, and not bullets. Amongst the weapons stored in the armouries about that time are mentioned "fire arrows for slur-bows" and "slur-bow bolts."

The slur-bow was a weapon chiefly used for military purposes, its steel bow being bent by the cranequin, or improved winding apparatus.

By the end of the 15th century we find the mechanism of the crossbow exhibiting a considerable ingenuity of design. The windlass was fitted with cords wound round by movable pulleys; these pulleys had protecting guards to keep the pulley cords in position, and, although not differential pulleys, were capable of exerting a great strain in pulling back the bowstring to the nut or catch. Every working part had been elaborated—the bow, the winding, the arrow bolt and the bowstring; so much so that when, at the commencement of the 16th century, the sporting crossbow, a much lighter implement, jumped into favour everything was ready for further development.

Our neighbours, the French, were the first people to move in this direction, introducing the ratchet-winder cranequin as simpler and more portable than the mediæval windlass, no cords or pulleys being used. The underlying principle of this new winding apparatus was the same as that of the old-fashioned lifting jack as used in timber yards.

The pictures of these light sporting crossbows show them to have been lavishly decorated, at once stamping them as being the treasured property of sportsmen and not of the stern followers of Mars. These more modern weapons of the chase had two triggers, of which one was a safety trigger; the other, a short one, was protected by a guard similar to that of the modern fowling piece. A backsight with a notched cross-bar, when aligned with the upper edge of the head of the arrow bolt, gave the sportsman his aiming line. The bolt was laid on the stock without the customary groove, the head of the bolt being supported by a small ivory notch.

The sporting crossbow was preferred by sportsmen and foresters for more than a century after the hand-gun or arquebus had made its appearance, chiefly, no doubt, for the silence of the discharge and for the fact that, owing to the frequent misfires and inaccuracy of hits and the variable powder, the hand-gun was not at that time a reliable weapon.

The earlier hand-guns or arquebus were wont to suffer much from windage; the bullet wobbled and rattled loosely down the barrel, until it was found that by using a crossbow arrow bolt, minus the feathers, exactly fitting the bore, penetration and accuracy of aim were much improved. That this was so is amply proved by the chroniclers of old, who state that bolts fired by the arquebus hit the bulwarks of ships, and indeed pierced them from side to side.

The more powerful cranequin crossbow for killing large deer, boar and wolves was discarded for a still lighter form about 1625. This lighter form was regularly used by hunters of game-birds, chamois, roebuck, hares and rabbits until 1730. Many of these beautifully constructed light crossbows with cranequins may still be seen in Continental museums, being largely made for the use of the chief foresters and

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keepers of royal domains so recently as the end of the first quarter of the 18th century.

But the desire to obtain a very light portable sporting crossbow soon led to the use of a very light arrow, which in Spain was of the poisoned variety, and which by merely penetrating the skin of a deer sufficed to kill.

A great Spanish hunter, Del Espinar, writing in 1644 quaintly describes its use :—"Both large and small game were readily killed by the weapon, except when on the wing or when offering a shot where rapid firing was required; in which case the arquebus or hand-gun made all easy for the would-be sportsman or common gunner." At that time all who were not of the truly finished sportsman type or "Crossbowmen" were termed "Hunters."

When speaking of those who were genuine exponents of the true art, "even if they be princes, it is usual to say 'the king is a great crossbowman'; hence much honour follows those who practice with the crossbow." He who earned this title had to be a general sportsman, acquainted with the habits and characteristics of all animals and game birds, and not a mere "Bird catcher" using snares, decoys, nets and other cunning devices. He who had an arquebus or hand-gun for killing large birds, rabbits or hares, or who used wire snares, was only a "Hunter." The term "Hunter" included also all those who "hunted partridges with a tame decoy bird or who laid snares of cord which they call 'Perchas.'"

They also who hunt at night with a dark lantern, which drives the birds into a net, are mere "Hunters." Those also are "Hunters" who use ferrets and nets and a pointer dog.

A picture by Olina of date 1622 is reproduced, showing *Le sport à la mode* in Spain. In it is depicted a grandee of Spain, accompanied by his wife, who is attired in classical garb, wearing a muff; the retainers are busily engaged attending to the *cuisine;* one of them is toasting larks, spitted on a revolving skewer worked by a windlass handle, over the licking flames of a field kitchen apparatus. In the vicinity is the state van, or family coach, drawn by six horses, with one postillion on the near hind. The "Crossbowman," who is arrayed in picture hat and plumes, shooting cape and knee breeches, is armed with a light stonebow. In the foreground in a rocky recess is spread out a sumptuous repast consisting of cakes or dough-nuts, in the midst of other dainties, embellished by the presence of two large carboys of wine. The surrounding trees are depicted as bristling with long spikes, impaling at their extremities diminutive birds, thrushes, larks and blackbirds, which have been caught by twigs smeared over with bird-lime, as carefully arranged for beforehand. The whole picture is representative of a style of luxurious shooting strikingly suggestive of a variety of modern sport under equally comfortable circumstances.

Another reproduction of a picture by the same artist illustrates a night attack on pigeons at roost, and their accompanying suite of smaller birds in attendance on the headquarter tree; four general sportsmen with crossbows are stealthily advancing from the four points of the compass; two huge bloodhounds or mastiffs, in an expectant attitude, are following at

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their heels; whilst two retainers, armed with big night lanterns in their left hands, are projecting fixed beams on to the slumbering birds; abnormally long-handled square-headed bats with nets are carried in their right hands, with which the pigeons are to be enmeshed. Another retainer is sitting down replenishing the oil in a troublesome night lantern; an oval-headed racket bat with net is reclining at his side.

A reference to the sporting illustrations in Sir R. Payne-Gallwey's voluminous record would be incomplete without allusion to the quaint drawings illustrating the MS. of Gaston Phœbus, a great writer on the chase in the 12th century. These drawings are descriptive of the cross-bow shooting of the wild boar, the ibex and deer.

Stradanus, a Flemish historical painter, who delighted in portraying all kinds of sport, such as shooting, hunting, fishing and coursing, is also reproduced in most realistic fashion. One of his pictures depicts an attack on a rabbit warren by crossbowmen. Five sportsmen armed with crossbows and daggers are advancing through a wood on the warren, and are ensconced behind the friendly shelter afforded by the trunks of antient oaks; the rabbits are being evicted from their burrows by fire and smoke. Purse nets and stop nets close the main entrances to the burrows; three rough-haired bull-nosed terrier dogs are engaged pursuing and mauling retreating rabbits. Two attendants, one armed with a lance pointed at one end, are picking up and despatching the wounded. In the middle distance with head and ears erect, peering from out their crannies, are those rabbits not yet engaged, interested spectators who are anxiously awaiting the development of the attack.

These accurately delineated pictures enable the reader to enter into the spirit of sport as indulged in in the mediæval days, when no opportunity was apparently lost of using every means which stratagem or cunning could devise in order to secure the biggest bag obtainable. That very little compassion was shown to the hunted animal may be partly attributable to the fact that the crossbow was nearly useless against a moving or a vanishing target; but on the other hand birds and beasts had not learnt to be so wary as they afterwards became when confronted with the noise made by the discharge of the arquebus or hand-gun.

As an example of stratagem in sport of the 14th century one of the pictures illustrates the method adopted for killing partridges as they feed by means of a stalking horse, in reality a man disguised as a cow with a bell round his neck, who under cover of a blanket steals up to the unsuspecting prey; he is accompanied by the sportsman with crossbow and hunting knife, who cowers under the near flank of the cow, thus disarming all suspicion on the part of the unsuspecting birds.

Another picture, suggestive of unwary and misplaced confidence on the part of the animals of the time, reveals a doe and her attendant stag tamely advancing in review order to be killed; each is marked down as legitimate booty by two crossbowmen, whilst another sportsman craftily concealed in reserve, is tautening up his bowstring in case of need. Although the pictures all show that the sportsman did not waste his skill by attempting too much at long ranges, being desirous of utilizing to the full the fire potential of his weapon at decisive or short ranges only, still,

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as is recorded by many an enthusiastic chronicler, the range capable of attainment, although always a varying quantity, was by no means a short one. Our gallant author, Sir Ralph Payne-Gallwey, has himself verified by personal experiment the ranges which mediæval crossbows can attain even after the lapse of so long a period of time as five centuries. Quoting from his results, it would appear that the range of a 15th century military crossbow with a thick steel bow, if elevated 45°, would average about 370 yards, the so-called point blank range about 65 yards. (It is noteworthy in this connection that very few of our crack modern archers are able to achieve a range of 300 yards). The average length of flight of the light sporting crossbow was about 350 yards but from the heavier military bow, weight 15½ lbs., a greater penetration and range was to be expected.

Although our ancestors were so supremely skilful with the longbow, it is doubtful whether the heavy-headed war arrow as used at Crécy or at Agincourt attained a greater distance than 250 yards, that is during the halcyon days of the longbow, when every jocund Englishman or callow youth, rich or poor, who could bend a bow was constant in his attendance at archery practice, voluntarily so, and if not by statutory power. But a range of 250 yards was found to be quite sufficient when put to the eminently practical test of stern warfare. Cool courage and accuracy of aim, coupled with rapidity of fire, were required and apparently obtained.

Nearly five centuries after Crécy our armies were fighting at Waterloo with the improved weapons of the day; but our author, in illustration of the slow progress in the improvement of arms, gives his deliberate opinion that:—"If a hundred marksmen armed with the Brown Bess (or Brown Arquebus) as used at Waterloo and 100 of the best archers at Crécy and Agincourt could be opposed to one another in line at 120 yards, the archers would gain an easy victory." He considers that the archers could discharge at least six arrows to every bullet fired by their foes, and that they would probably be more accurately aimed, and being barbed have greater effect.

Extra long ranges with the bow have however been shown to be possible with specially constructed implements unsuitable for war or even for target practice. The Turks excelled in these long-range practices, but they used a particular form of miniature flighting arrow for the purpose. In 1795, before the Toxophilite Society in London, the Secretary to the then Turkish Ambassador is said to have shot such an arrow a distance of 482 yards, but being out of practice at the time the shot was considered merely as a sample of what any Turk could do. These long-distance arrows were very light, made chiefly of bamboo with a light steel or ivory cap for a head; a little piece of hard wood formed the notch, the feathers being formed of two strips of thin paper, varnished, to keep them hard and upright. To the wrist of the archer's bow arm was buckled a flat strip of grooved horn to hold the head of the arrow; by this means the archer turned himself into a gigantic animated crossbow; drawing the arrow head full stretch a considerable distance back beyond the bow head, he attained an immense range thereby.

The Ottoman emperors were expert both in the theory and practice of

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archery. Every emperor was supposed by tradition to be the master of some manual trade, and indeed to be capable of earning his living in that way. Many of them, instead of learning an art or profession, preferred to devote themselves to the art of making bows and arrows, with which they afterwards performed prodigies in shooting. Some of their records are carved deep on the columns in the Place of Arrows in the suburbs of Constantinople. Amongst the record flights are those of Pashaw Oglee Mehmed, 762 yards; the grand admiral, Hussein Pashaw, 764 yards carry; but against these triumphs is the record of the reigning emperor, Sultan Selim, who shot two arrows in succession into the air, the arrows lodging in the ground at the extreme distance of 838 yards and thus beating all subordinate records.

One late development of the crossbow, sometimes to be met with in the gun-rooms of old country houses near rookeries, is the weapon known as the bullet-shooting crossbow, popular about the years 1800—1840. It was a more powerful edition of the 16th century stonebow, was intended to kill rooks and rabbits, and was contemporary with the improved air gun with a hollow stock that superseded the air gun, invented in 1560 by Guter of Nuremberg, which held the compressed air in a metal ball below its barrel.

After the introduction of rook rifles about 1840 the old-fashioned bullet crossbows and air guns were laid aside for serious work, except for poachers' use for killing pheasants at roost, the discharge being a silent one. One German regiment of infantry was still armed with Guter's air gun at the commencement of the 18th century.

The enclyclopædian treatise which Sir Ralph Payne-Gallwey presents to his country takes us along with it away down the years from the time of Archimedes to Waterloo. Many of the changes it describes strike us of being of very slow growth, and of not so revolutionary a character as might have been expected even after the discovery of the new propellant in the form of gunpowder. It took quite a few years to replace the crossbow and pike by the rifle and bayonet, many of the old-time methods having been curiously re-invented at different times in the course of our national history.

The modern re-arming of cavalry with a shooting weapon in addition to their personal body weapon would appear to be but a retroversion to the tactics pursued by the Spanish mounted crossbowmen of the 14th century, the long sword and the dagger being mere adjuncts of the crossbow or shooting weapon. Shock tactics and the use of *l'arme blanche* were not the exclusive *rôle* of the Spanish mounted crossbowmen as they were of the Roman mounted scouts before them, who invaded Caledonia in A.D. 149 and who carried no shooting weapon. Archimedes, by employing original mechanical devices during the siege of Syracuse, gave a fresh impetus to the value of secret weapons, but these secrets, probably owing to their simplicity, did not remain for long the sole property of the Greeks. After the discovery of gunpowder the English people were apathetically slow in discarding their cherished longbow, until forced to do so by the unrelenting progress of events.

Repeating or magazine weapons, although used by the Chinese from

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time immemorial, were not required by this country until quite a recent date. And why should it be otherwise in the case of an insular nation accustomed for ages to rely on its bulwarks of ships, and on the manliness of character and endurance of its inhabitants, in the absence of any striking development in secret weapons on the part of their probable adversaries? The various improvements both in the engine, the propellant, and the projectile have been very gradually evolved during the period dealt with in the great work under review. But what is so ineffably pleasing and instructive in the reflections conveyed to the mind of the reader by a careful study of Sir R. Payne-Gallwey's work is that, the part which the military mechanical engineer has played in the evolution of weapons has been mainly responsible for all those improved and any secret weapons which we may now possess; and that the first great advance was initiated by that grand old mechanical engineer, Archimedes, during the siege of a fortress, an operation which may in the future demand the concentrated strength of the greater part of the engineer force, and which will most assuredly give full scope and occupation for all the mechanical talent and ingenuity which may be possessed by the members of the various branches of our versatile corps.

O. E. RUCK.

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NOTICES OF MAGAZINES.

KRIEGSTECHNISCHE ZEITUNG.

Year VII.—No. 1.

THE TECHNICAL MILITARY ACADEMY.—Opened on 1st October, 1903, for the dissemination of technical knowledge in the Army. Officers of the Communication Troops and of the Departments of the Army, as well as those who wish to prepare themselves for transfer to the Engineer Corps, are to be given such opportunities, as Military exigencies will permit, to receive instruction of a theoretical and technical nature.

Hitherto it has only been officers of Pioneers who were able to prepare themselves for the Engineer Corps by studying at the Artillery and Engineer School, but now every officer can have a chance of preparing himself for transfer to the Engineers in the New Academy.

The School of Engineering now only exists in name, for although Pioneer officers are able to put in a 12-months' course there, Engineer officers are not fully trained there. The Engineer Corps is now in a transition stage, and its completion and organization are still in the womb of the future.

The Academy is under the Inspector-General of Military Education and Instruction; the Inspector-General is the official Chief of the Academy, which is in communication with all other heads of technical branches and arms of the service, so that the training may be carried out in harmony with their respective requirements. On the other hand the War Academy, which, in many respects, is similar to the one under review, is under the Chief of the General Staff of the Army.

The Director of the T.M. Academy holds the rank of Brigadier-General. He commands the Academy in all respects. Associated with him is a staff officer as Assistant Director, who carries out the discipline and interior economy according to the Director's orders. Under him come the officers attending the courses and certain rank and file, with regard to whom he has the same powers of punishment as a battalion commander in garrison.

The Instructional establishment consists of military and civilian instructors, supplemented by honorary instructors paid from the Academy funds.

To help the Director in the arrangement of courses there is a Commission of Studies, presided over by him, consisting of staff officers or captains of (*a*) The General Staff, (*b*) Engineer Corps, (*c*) Communication troops, (*d*) Military Artificers, (*e*) Commission of Inspection of

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Arms, (*f*) Artillery Experimental Commission. With these are associated several experts whose number varies with circumstances.

This Commission settles the programme of studies for the year, and tells off the instructors to their respective classes. It also arranges for certain specified instructors to issue the papers for the entrance examination.

For the present the test only consists of mathematics and physics. The Inspector-General will determine how long this is to continue. The papers are done by the officers in their garrisons, three of mathematics and two of physics, of which at least two and one respectively must be done, two hours being allowed for each. On conclusion the examinee has to sign a certificate that he has done his paper without anybody's assistance. Books may be used for reference, but their names must be reported.

The Commission of Studies has to mark these papers. It has also to settle the scope of intermediate examinations, check the syllabus of subjects, set the papers for the final examinations of each year, and look after scientific compilations.

The military members of the Commission have besides to be present at certain branches of the instruction, specified by the Director, to take note of the talents and capacity of the students; they have also to be present at the examinations.

The Academy course comprises three terms in three years, from 1st October to 30th September. The 3rd term concludes the course for the 3rd termers, and also for those of the 2nd and 1st terms who are not considered fit for further instruction. Fifty officers at most are told off to the 1st term and these pass on according to their merits to the 2nd and 3rd terms.

The students are Lieutenants or First Lieutenants, with a minimum of 3 years and a maximum, as a rule, of 9 years service. Besides possessing the qualifications tested by examination, with a disposition and talent for learning and technical knowledge, they should have distinguished themselves in some manner with their units, have obtained a character for solidity and good education, be financially unembarrassed, and pass the doctor.

Foreign officers are not admitted.

Individual officers and military Medical officers may be permitted, on application by their C.O.'s, to attend lectures and demonstrations in the laboratories. The advantages of this are obvious.

A narrow military training is avoided since some of the lectures are delivered at the technical High School of Berlin. To illustrate the lectures personal visits are made to workshops and factories; and it is hoped that the large works of private industry will not be left out, so that branches of science not dealt with in Military Establishments may be studied.

In the interval between the terms the officers of the 1st and 2nd terms are generally sent to a unit of some other arm than their own, or occasionally to Technical Institutes. This part of the order appears to require some modification, for it is to be hoped that officers training for

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the Engineer Corps may be sent to some fortification or other new work, and those for Communication Troops to railways, telegraphs, etc.

The duration of these recesses is settled by the Director. The theoretical studies for all three terms closes on 30th June. The 1st termers now go on detachment to the Artillery or Infantry as the case may be. The 2nd termers do practical reconnaissance till 21st July and then go to duty with a Cavalry or Infantry regiment as the case may be. The 3rd termers begin their final training journey (which I take to be a sort of Staff Ride) which ends on 21st July. For these duties the officers receive travelling expenses going and returning, so long as they go to an unit of their own Army Corps; if they wish to go to another Army Corps they must forego this allowance; the reason for this is not clear. Throughout their course they also receive extra pay of 36 marks per mensem, a privilege, so the author says, not extended to the students of the War Academy for some unaccountable reason.

At the conclusion of their course, the officers are granted a Leaving Certificate which specifies their attainments. In certain cases it is stated whether an officer should be sent to a Technical Institute, Inspection of Arms or Artillery Experimental Commission, or whether he appears suitable for the Instructional Staff. Especial merit leads to special consideration of the individual or even to recognition by the highest power in the Annual Gazette.

No reports on the merits of officers are sent by the Director to the C.O.'s of units before the completion of the 3rd term, so that special consideration may be avoided.

Leave during the course is only granted under pressing circumstances by the Director or Inspector-General. Applications for leave, which, if granted, would interfere with the applicants being attached to another Arm or Institute are only permissible under very special circumstances.

Disciplinary measures are exercised in the first instance through the Commandant of Berlin. Appeals are dealt with by the Governor of Berlin.

In questions regarding honour the officers are under the jurisdiction of their own units; all the same, a Court of Honour has been formed in the Academy to which officers can refer without the necessity of recourse to Corps in Berlin garrison.

On 1st November of each year the Director lays before the Inspector-General an opening report for the year just beginning and a yearly report for the year just concluded. The last must be so conceived as to be presentable to the highest power.

The 1st and 2nd Classes of the Academy are each divided into 3 sections, viz., Arms, Engineering and Communications. In the 3rd Class, from the Arms section are formed two sub-sections, viz., Construction and Ballistics, so that the 3rd Class is divided into 4 sections.

In addition to the lectures which are obligatory, voluntary classes for French, English and Russian are formed, provided the numbers for a class are made up. Once begun they must be gone through.

Instruction in purely scientific and technical branches is imparted by teachers of the High School and when possible at the High School itself.

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In the 1st Class all three sections are taught mathematics, mechanics, physics and the rudiments of experimental chemistry. In the Arms Section are taught the knowledge of arms, ballistics and drawing of details of construction of arms.

In Engineering comes the technical details of fort building, drawing of fortifications and knowledge of weapons. In Communications come bridge construction theory and working drawings.

The following subjects are dealt with subsequently in the 2nd and 3rd Classes, viz. :—Thermodynamics, electrodynamics, military technical chemistry, ballistics, elements of machine design, metallurgy and iron-founding, estimating, the art of fortification, tactics in the field, machinery, railway traction, use of railways in war, principles of campaigning, armour-plating, strength of materials, photography, explosives, communications in war, fortress warfare, railway traffic management, telegraphy, telephony, gas engines, automobiles, theory of airships.

The author concludes by expressing a pious hope that, when they have absorbed all this knowledge, the officers concerned will have reached a pinnacle of technical knowledge worthy of an army so important as that of Germany.

THE SIBERIAN RAILWAY AT THE OPENING OF THE RUSSO-JAPANESE WAR (*conclusion*).—This was built at the cost of the Russo-Chinese bank, under whose control it remains in a measure.

The work had to be pushed on as quickly as possible to bring up material for the 1,100-k.m. stretch in Western Manchuria, which is almost destitute of timber, and again for portions in Eastern Manchuria towards Ussuriland, where for hundreds of kilomètres no building stone is to be found. Moreover, it was necessary to bring labour from Chifu and Tientsin, etc., and to furnish supplies in this almost desert country.

When the disturbances arose in 1900 it would have been impossible to forward and victual the troops without a continuous line of rails of some sort. So all obstacles were run round, temporary wooden bridges put up, and diversions laid that admitted of earthworks being deferred. Meanwhile the formation level was being carried out according to design, and as it advanced the rails were laid in the proper manner and were used to supplement the rough line. Where hills had to be crossed, winding inclines were put up to begin with. The maximum incline was put up at 1½ per cent. on the straight. As a rule, curves were never sharper than 425 m. radius, though there are exceptional ones of 256 m. On the flat, maxima and minima are represented by ·8 per cent. and ·6 per cent. for a length of 640 m.

As works of art are to be mentioned 14 bridges over 200 m. long and those over 640 m. long crossing the Nonni, the Ssungari (2) and the Hung-ho. The Ssungari bridge at Charbin (950 m.) is 60 m. longer than the Jenissei bridge, and is only exceeded in length in Russia by those over the Volga and Amu Darya. Drainage openings are set at 9 m. per kilomètre. All the large bridges have masonry piers and abutments and iron superstructure.

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The Chingan mountain tunnel, 4 k.m. long, is worthy of mention. While it was being pierced a 20-k.m. diversion, with heavy gradients and two reversing stations, was opened and worked. The tunnel has now been in use for some time. The finished embankment is well made; it is 5·55 m. in the crown, well above flood level and the sides well sloped. The permanent way is of rails 33·2 k.g. to the metre and well ballasted (nature of sleepers not mentioned).

There are no difficulties about water. There are plenty of pumps where gravitation supply has not been completed. The machine shops and repairing shops are on a permanent footing.

Dwelling houses, churches, schools, libraries and hospitals have been liberally provided. Apart from the offices and other public buildings, 48,230 sq. m. of dwellings = 191 sq. m. per kilomètre, had to be provided, of which the greater part are for railway officials. These work out at about $\frac{1}{3}$ the usual allowance for Russian railways, but they are declared to suffice for the requirements of the case. These buildings had to be put up of anything that came handy at first—clay, wood, earth, and such like, and many of these are still in use. The new buildings are mostly of freestone or brick; timber and frame houses in wooded districts.

Whatever may be said against this railway, it at any rate had the same carrying capacity as the Trans-Baikal line at the beginning of the war. The trains are of 44 wagons. The wagon park, which was very defective last year (1902), has been increased by many newly purchased engines and carriages of the very best description for working in the excessive heat of summer and bitter cold of winter. The carriages turned out by the Rigaer wagon works are highly spoken of. Altogether the Manchuria railway is not to be despised, and its rapid construction reflects great credit on Russian enterprise, considering that it was completed in time of war; and on account of the uncertainty of the political situation it has remained throughout on a war footing.

The Russian line of communications from Moscow works out at about 8,500 k.m., thus:—

	K.M.
Moscow to Tschelfabinsk	2,200
West and Middle (officially East) Siberian section up to Lake Baikal	3,320
Circum-Baikal line	260
Trans-Baikal line from Myssowaja to Kaidalowo, and from there to the Chinese border (station Mandshurija)	1,200
Manchuria Railway from the border to Mukden, about	1,480
	8,460

The Siberian railways are State Railways, and the Manchurian line, as an undertaking of the Russo-Chinese Bank through the Finance Minister, is directly dependent on the State.

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Nevertheless, the chain of responsibility is complicated enough, and the following will show that this is not without influence on the working of the whole line.

The Ministry of Communications, Finance Ministry and Controller General of the Empire are all interested in railways. While the last mentioned has to oversee the projects, the Finance has an influential voice in voting the funds, and in the case of the Manchurian railway has had to mix itself up in decisions that trench on the duties of the Communications Ministry. The last, again, is the highest executive organ for construction and management, and is to a certain extent subordinated to the Standing Committee for Siberian Railways, which has been working for the last ten years under the Emperor as president.

The local management of the lines (West and East Siberian and Trans-Baikal) is under the General Manager, who is supported by a standing Council composed of representatives from the three ministerial districts concerned and his departmental Chief. In the Great General Staff at St. Petersburg the 1st section, the "Management of Military Communications," is concerned with the study of communications in general, railways in particular, and waterways of the Empire, the organization of transport in peace, and certain personal and managerial matters.

Meanwhile the 2nd section, "Mobilization," deals with mobilization transport, war and mobilization traffic, management of the railways, organization of *étappen* management, post and telegraph services in the theatre of war, preparations for the disposal of sick, wounded and prisoners, and finally the arrangement of hospital trains.

In military districts there are railway staff officers subordinate to the Director of Military Communications.

Moreover, the special needs of the war have called into being a working "Committee for the organization of railway transport to the Far East," under the Chief of Military Communications in the Great General Staff. Its duties consist in co-ordinating all war railway transport to Siberia and the Far East, including the Red Cross Society private institutes and persons; also in taking measures to secure and maintain an unbroken traffic to the Far East, and to ensure its safety and punctuality. The decrees of the Committee are binding, but must be carried out through the agency of the Ministers concerned.

In addition to all this, conformably to the recent general order on the organization of the Army in the field, there is a special section of the General Staff of the Commander-in-Chief in the field which deals with the general scheme of communications by rail and river. These are the Trans-Baikal and Manchurian railways (except the portion Charbin-Pogrunitschnaja), and the rivers Schelka, Amur and Ssungari. It is only the extreme length of the line of communications that prevents the influence of this section of the local staff from reaching as far as the European border, added to the circumstance that the Circum-Baikal, Trans-Baikal and uncompleted portions of the Siberian railway demand the intervention of the Minister of Communications, so that in a measure a compromise between peace and war working has proved itself necessary.

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For protection of the line it has been found necessary to put the whole, as far back as the Ural Mountains, under martial law. The measure is justified by the fact that Chinese and Japanese workmen have engaged themselves in the railway works, and, as many detected cases of foul play testify, are capable of undertaking all sorts of mischief. The inhabitants of the country along the line are held responsible for its safety. The portion on the other side of Lake Baikal, in which the bridges and other works of art are numerous, demands extra special supervision by the military. As a means of protecting the line, the remarkable proposition for the troops to get out of one train and march along the line till the next coming train could be emptied and pick them up is an example of what extraordinary fancies can be evolved by the brains of civilian strategists.

Even in peace time the Manchuria section demanded careful watching by troops, to protect it against the raids of the Chunchuses. The Border Guard, which consists of 55 sotnias, 55 companies and 6 batteries, total 25,000 men, has nothing really to do with the border, but is distributed over various fortified posts and patrols the line. Besides these there are detachments 60 versts distant on either side of the line, and these are in constant conflict with the Chunchuses. That the Border Guard will be able eventually to take on this duty is a matter of doubt, for the Chunchuses, it appears, have been organized by Japanese officers for cutting communications.

The Chinese authorities have issued stringent regulations forbidding the carrying of arms by unauthorized persons and urging instant co-operation of the inhabitants with the Border Guard.

The employment of Chinese on the line is forbidden, and civilians are only admitted under careful supervision; moreover the opening of windows on bridges and in tunnels is forbidden under threat of severe punishment. So far serious damage has been prevented, and even the attempts of patrols of disguised Japanese frustrated. The only serious loss was the burning of 850 tons of coal and 88,000 c. metres of wood in April and May.

The *personnel*, which was quite insufficient for increased working, has been supplemented by men from the South-West railways and Orenburg-Taschkent line. In the theatre of war the Trans-Amur Railway Brigade of 4 battalions is at work on the line.

The traffic was 4 military and 2 other trains daily. The rolling stock has since been augmented from the reserve of the Government, and some 200 locomotives have been transferred from other lines.

One of the difficulties to be met was the cleaning of the wagons and carriages; so halts are made after 3 to 4 days' journey for 1 day, the troops are turned out, and the trains cleaned. Some of the halting places, notably those in European Russia, are not well provided with accommodation, which takes the form of old market stalls, a few special buildings and lined buildings of sorts. Across the border in Asiatic Russia the stations Ob, Krasno-jarsk and Inokentjewskaja are provided with new double-storied barracks, the first two each for 500 men, the last for 4,000 men, besides stabling. Each story has lavatories and baths, with water

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laid on, and kitchens, etc. There are also disinfecting establishments. The officers are provided with quarters and mess room. Although the trains are cleaned thoroughly during the halts, nothing of the sort can be done for the barracks, and latest reports describe these as in a filthy state.

The supply arrangements provide for a warm meal to all hands once in 24 hours. Each supply station has cooking appliances for 1,000 or 2,000 men, and dining halls for 500, and the necessary accommodation for *personnel*. Some even have bakeries. The troops can also draw their rations raw and cook them in their travelling kitchens.

It is calculated that under favourable circumstances the number of trains run has been :—

From 1/14 February to 1/14 May 4 military trains daily, and from the latter date this has been increased to 6.

Out of the 4 trains for the 100 "train" days before 1/14 May probably 2 and at least 1 daily has been for war material and supplies.

Judging by the fact that the halting points only provided for 500 men daily, it may be concluded that the 35 wagons per train have not been fully utilized. However, from the figures above we deduce that the trains run have been something between 246 as a minimum and 346 as a maximum ; and these at 500 men per day put the reinforcements delivered at the front between 125,000 and 175,000 men.

As regards speed, authorities are at variance. But assuming 20 k.m. per hour as far as Lake Baikal and 15 for the remainder of the line, we get :—

To Lake Baikal $\frac{5500}{20 \cdot 24} = 11\frac{1}{2} + 3$ rest days	$= 14\frac{1}{2}$ days.
Crossing the lake	$\frac{1}{2}$
Lake Baikal to Mukden $\frac{2680}{15 \cdot 24} = 7\frac{1}{2} + 1$	$= 8\frac{1}{2}$
	$23\frac{1}{2}$

If we put this at 30 days from Moscow to the front we shall be not far wrong.

The rest of the article comprises calculations as to what troops were present with General Kuropatkin in July and up to the date of the article (not given).

The author concludes that this report will convince the readers of the want of veracity of the American and English reports, which very much understate the capacity of the line. But it is the slowness of the arrival of reinforcements and the fact that the capacity of the line is now stretched to its utmost elastic limit that most probably contribute to the passive attitude adopted by General Kuropatkin.

Year VIII.—No 1.

"LIGHT TELEPHONY" AND ITS USE FOR MILITARY PURPOSES.—By Oberleutnant Von Hoffschlaeger, 4th Engineer Inspection.—With 12 plates.—Proposes the use of wireless telephones to supplement or replace wireless telegraphs in the field.

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Briefly, the author proposes to reproduce the inflections of the voice in an arc light and to transmit these by means of an ordinary parabolic projector to the receiving station. This latter consists of a similar projector with a selenium cell fixed in its focus. The selenium is acted on by the variations in the intensity of the rays from the transmitter, and so undergoes variations in conductivity that are reproduced in a telephone connected up with it.

ARTS AND TRADES AT THE SERVICE OF THE RUSSIAN WAR OFFICE.—By Captain von Toepfer, Instructor in the War School, Dantzig.—Industry is only prepared to produce in war what she has been accustomed to do in peace. It is only a highly developed industry that, in a military technical sense, can render a country independent and ensure it against the hostile efforts of a country more advanced in its industrial development. Contemplating Russia from this standpoint, we must confess she has made enormous strides in the last few years.

She is almost independent of foreign sources in steel work, *e.g.*, guns, projectiles, armour plates, etc. To Professor D. K. Tschornoff is due much credit for his experiments and discoveries in tempering steels; and when Krupp's armour-plating secret was purchased, it was found to be no secret, but a process based on the identical principles enunciated by the Professor for gun making in the Obuchoff Factory.

Since the Harvey process was discovered the Russians have succeeded in hardening plates to resist Lyddite shells, as proved by the war in progress. They have now purchased the process for producing double curved steel plates, so that ere long foreign orders will cease to be necessary. So all steel work, with the exception of the plates which the Ishora and Obuchoff Works are unable to undertake, is from Russian sources.

The building of ironclads is not up to the standard required, so that many new ships must come from abroad. The Admiralty, Baltic and Nikolaus Works can undertake liners and cruisers. The Newa Works build protected cruisers, the Admiralty, Baltic, Newa, Putiloff and Crayton can manage torpedo boats, and ships' fittings come from the Baltic and Franco-Russian Works.

Guns of all classes, except the revolver cannon from England (probably "Colt" guns), are home products. The Obuchoff Works turn out the ships' guns of heavy and medium calibre; the remainder come from Perm. The Government Factory in St. Petersburg produces castings, and the mounting of the three-inch (76 m.m.) guns is going on at Putiloff Factory.

The remainder of the article is best reproduced in the form of a catalogue.

Briansk.—Projectiles, large calibre; carriages, limbers, wheels, harness and fittings.

Isheff.—Sword steel, barrels, axles, naves, rifles, instrument steel.

Ishora.—Metal cartridges, sea service.

Kasan.—Smokeless powder, S.S.

Kijeff.—Carriages, limbers, wheels, harness and fittings.

Lugansk.—Cartridges, S.A., sulphuric and nitric acids, and æther.

Obuchoff.—Projectiles, large calibre; gun carriages and mountings, S.S.

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Ochta.—Percussion caps, smokeless powder, S.S.; melinite, sulphuric and nitric acids and æther.

"*Open Market.*"—Projectiles, small calibre; L.S. carriages, limbers, harness wheels and fittings; gun mountings, S.S.; metal cartridges, L. and S.S.

Perm.—Projectiles, large calibre and L.S.

St. Petersburg.—Projectiles, large calibre; carriages, limbers, wheels, harness, fittings, cartridges, S.A.; brass and "maillechort."

Putiloff.—Projectiles, large calibre.

Schastka.—Smokeless powder, S.S.; sulphuric and nitric acids, and æther.

Schusselburg.—Smokeless powder, S.S.

Slatoust.—Projectiles, L.S., and *armes blanches.*

Ssjestrorjäzk.—Lances, rifles.

Tula.—Rifles and revolvers, cartridge cases, S.S.

Matériel for technical troops, railway gear, engines, bridges, fortification work, pontoon and trestle wagons, and telegraphs are all home products. Telephones are imported; so are, with a few exceptions, all the elements of ballooning. Electrotechnic is not up to the mark, so that much apparatus has to be imported. The same remark applies to instruments of precision. Besides the above, large quantities of coal for the fleet, lead, copper, tin, zinc, and medical and surgical appliances have to be brought from abroad.

Great efforts are being made to push the use of petroleum on warships, and the Dresel motor is being utilized by the Nobel firm for generating electrical power, so that the large supplies of petroleum at command of the Empire may be adequately utilized.

ELECTRIC MOVING TARGETS.—With 3 plates.—Describes the apparatus now in course of adoption for moving targets. A complete train consists of:—

2 Fowler traction engines, complete with dynamos, 1,250 rev., 230 v., 10 kilowatt.

2 battery wagons, each of 60 elements of 75 ampère hours.

2 drum wagons and cables, each of 5 drums, holding 2,500 m. of 5-mm. diam. steel rope.

1 water cart.

The whole train is taken in tow by one of the traction engines.

The train can be either assembled or arranged in two groups for working one large set of targets or two smaller sets,

One drum wagon can deliver either 4 Infantry targets, "Quick" or "Double," or 2 Cavalry targets at "Gallop." If the Cavalry are required to go faster than 400 m. to the minute, the dynamo must be switched on to help the accumulators. If 4 Cavalry targets are wanted from 1 drum wagon, you turn on both batteries and switch in one dynamo if necessary.

The author does not describe the targets.

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THE MIKROPHOTOSCOPE, THE NEW GENERAL STAFF MAP MAGNIFIER.—An ingenious little instrument with eyepiece and lens, 13½ linear, in which is inserted a reduction of the map required on a scale of 1:100,000 in an area of 4 to 5 centimètres square (say 2″×2″). The eyepiece is movable and commands a field of about 175 square kilomètres. For night work an electric glow lamp is provided. The secret lies in the "diapositive" reproduction of the maps, for which a special secret emulsion is requisite. The whole thing is carried in a portable case, said to measure in all 8 c.c.m. (?). Anyhow, it is very portable, and seems worthy of trial. Apparatus complete with spare battery and 6 diapositive maps 25 marks (25s.); each new diapositive 90 pfg. (about 10½d.), each new battery 30 pfg. (say 4d.).

A certain amount of practice is required in using the lens, which must be accurately focused. Spectacles, eyeglasses, etc., should be removed, and the author recommends the owner never to lend his instrument once he has got it to suit him. To be obtained from Herr Dr. Otto H. F. Vollbehr Halensee, Berlin, 130, Kurfürstendamm.

J. A. FERRIER.

NATURE.

MOUNT EVEREST.—In 1848 trigonometrical surveyors commenced to build a line of survey stations along the plains of Oudh and Bengal, and to determine the position of these stations in latitude and longitude. Sir George Everest had intended to carry the series among the mountains, but abandoned his design in consequence of the refusal of the Nepalese Government to allow the surveyors to enter their territories. At almost every station the snow peaks of Nepal were visible, and Sir Andrew Waugh ordered that the true direction of every visible peak and the angular elevation of every summit above the horizon should be determined from every observing station.

From the observed angle of elevation and from the calculated distance of the peak from each station the height of the peak was deduced. If the several values of height were accordant, the identification of the peak was accepted.

Numerous peaks were found to have been observed only once or twice, and could not be identified; but in 1852 the chief computer found that a peak designated as XV., which had been observed from six different stations, had been found to be higher than any other peak in the world, though on no occasion had the observer suspected that he was viewing through his telescope the highest point of the earth. The mean height of the six observations was 29,002·3 feet; and so accurately had the angles of elevation been taken, at an average distance of 111 miles, that the minimum divergence from the mean was only 12 feet and the maximum 24. When the possible errors due to refraction, changes in temperature and atmospheric pressure, and personal equation are considered, the accuracy of the result is extraordinary.

Sir Andrew Waugh had always adhered to the rule of assigning to

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every geographical object its true local or native name, but here was a mountain, the highest in the world, without any known name. He determined, therefore, to call it Mount Everest, after Sir George Everest, his former chief, the great Indian geodesist. Mr. Hodgson, however, who had been political officer in Nepal, said that Sir Andrew Waugh had been mistaken, and that the mountain had a local name, viz., Devadhunga All subsequent information goes to show that there is no *peak* in Nepal called Devadhunga, which is merely a mythological term for the whole snowy range, and in 1854 Schlazenweit saw the mountain so called by Mr. Hodgson, identified it as Mount Everest, and certified that the local name of the peak was Gaurisankar, and not as stated by Mr. Hodgson.

In 1903 Capt. Wood visited Kanka by order of Lord Curzon, and found that Gaurisankar and Everest were different peaks 36 miles apart, and that Everest, the highest of the two by 5,562 feet, was not a conspicuous peak, being almost obscured from view by intervening ranges. Everest and Gaurisankar are separated by a wide interval and a deep valley, and are not spires of a single pile; the latter is remarkable in Nepal for the pre-eminence of its grandeur, the former, screened from the gaze of man, is known only as the highest point of the earth.

After fifty years of discussion the Hindu and Nepalese names have been proved to be inapplicable by Captain Wood, an experienced British surveyor, equipped with instruments and with full permission to use them; and it is to be hoped that Continental geographers, who have hitherto attached the name of Gaurisankar to the famous peak that we call Everest, will, in the interests of scientific harmony, now accept the name that has always been accepted in India, and suffer the English name to rest on our maps in peace.

THE RECENT DEVELOPMENT OF PHYSICAL SCIENCE.—By Whetham.—The author has sought to express the results of recent physical science investigations in a form which might prove useful to students of science in general, and "also appeal to those who, with little definite scientific training, are interested in the more important conclusions of scientific thought." Foremost among these problems must be placed the structure of matter, the mutation of energy, and the nature of comets and nebulæ. Suggestions have recently been made by Lord Kelvin and Professor J. J. Thompson that the internal motion of the atom, be it that of a vortex ring or of a moving electron, may perhaps be drawn upon to supply the energy that is liberated from the hidden storehouse by the radio-active element. Mr. Whetham devotes two chapters to the liquefaction of gases and the phenomena of fusion and solidification. He shows that even a brittle, metal-like antimony can be made at ordinary temperatures to flow like a liquid.

The final chapter contains an account of the more recent results of spectroscopic investigations of the sun and stars. The pressure due to radiation is considered and applied to the explanation of the curious phenomena of comets' tails, whilst the mutual repulsion of radiating particles is suggested as a possible explanation of the permanence of Saturn's rings.

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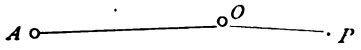
MATHEMATICS OF BILLIARDS.—Mr. Hemming, K.C., in his treatise on this subject, discusses the comparative advantages of fine and through strokes, with regard to the margin of error permissible in the respective cases.



If A is the player's ball, O the object ball, then the stroke is to make A, after striking O, pass within a distance of the point P, depending on the nature of the stroke, namely, for a cannon a distance equal to the diameter of a ball, for a losing hazard the necessary distance from the centre of the pocket. Mr. Hemming calls the angle AOP, $\pi - \Delta$, and finds that the margin of error is the same for the through as for the fine stroke when $\sin \Delta = 0.320$. For smaller values of Δ the through stroke has the advantage, for larger values of Δ the fine stroke until a certain maximum is reached.

W. E. WARRAND.

REVUE D'ARTILLERIE.

October—December, 1904.

WIRE-DRAWN STEEL INGOTS.—Said to be an improvement on Whitworth's compressed steel, and to possess many advantages as regards the quality of steel turned out, reduction of waste and cheapness of working, owing to diminution of the forging required. The process is known as the Procédé Harmet. The article is fairly long and is illustrated by several plates. A certain knowledge of the subject is requisite for its comprehension.

NOTE ON RANGE-FINDERS.—An interesting study of the subject, which lucidly explains the difficulties encountered in designing an instrument sufficiently simple to be of use in the field of battle. The guiding principles of the generality of range-finders are described, and calculations given shewing their limits of error. The article is summarized in a short essay debating the actual value of range-finders in the field, and the conclusion arrived at is that they seldom can be used, although the author admits that well-trained infantry who shoot well feel a necessity for a range-finder, while well-trained gunners can very well dispense with it.

The Germans stick to the "Minostatic" range-finder, of which there are many patterns—Gautier, Le Cyre, Christie (Greenwich Observatory), Souchier,—but something much simpler and less costly is required. Full value can only be reaped from such instruments by having plenty of them and making a practice at every halt, whether in peace or in war, of each squad taking the range of noticeable points, so that every soldier when the fight begins may have one or more approximate ranges fixed in his mind. Put thus, the problem does not appear insoluble, but the men concerned are the best qualified to pass a sound judgment on an instrument of this nature. There is one criterion that never fails. If the men make use of an instrument of their own accord, well and good. If they have to be ordered to use it, most probably it will prove a failure.

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January, 1905.

A RUSSIAN MACHINE-GUN COMPANY AT THE BATTLE OF LIAO-YANG.—A letter from the officer in command, who begins by complaining that nobody seems to know or to understand what machine guns are for. The description of his experiences is graphic and confirms, by practice, a good number of the theories propounded as to the conditions under which machine-gun units can be used or abused.

He comes under artillery fire to begin with and finds himself paralysed, as far as useful action is concerned, for 15 hours. He is then sent off to a flank at night and takes up a position under cover on the edge of a village. Here he is able to be of some use, and catches a mountain battery in column of route at 1,200 paces and wipes it out.

Then after two hours' quiet he gets bothered by sharpshooters; these he clears out, with the result that an organized attack of skirmishers is directed on his village. This he is able to keep at bay, thanks to the millet having been cut in front of him.

But night is the dangerous time for machine guns, which are then powerless, and at dawn the snipers have come too close for him to be able to clear them out with the machine guns, for the exposure of a hand was enough to bring down a hail of bullets. So these snipers, some 25, had to be cleared out with the bayonet, and so on.

The conclusions drawn are:—

(i.). Impossible to face artillery in action.
(ii.). At about 1,000 m. troops on the line of march can almost be wiped out, provided progressive (*i.e.*, increasing elevations) and sweeping fire be adopted.
(iii.). Beyond 700 m. machine guns have displayed superiority over skirmishers.
(iv.). Beyond 2,000 m. fire should not be attempted.

There are 8 Maxim guns, 7·6 m.m., 5 officers, 90 N.C.O.'s and men, 56 horses, in a Russian machine-gun company.

J. A. FERRIER.

REVUE MILITAIRE DES ARMÉES ÉTRANGÈRES.

November, 1904.

MILITARY BALLOONS AT PORT ARTHUR.—The balloon equipment despatched to Port Arthur was captured by the Japanese on board the steamer *Mandchouria*, which they seized during the first few days after the opening of hostilities; and it was impossible to replace it before communications were cut off.

Nevertheless, Lieut. Lavrov, who had been through the course of instruction at the Balloon Depôt and was appointed to command the balloon detachment detailed for the fortress, had arrived during February, and was able to remedy in some measure the absence of the equipment.

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He constructed one balloon from silk found in the city, purchasing the whole stock, and another by utilizing bed sheeting. For varnish he used plain linseed oil; and the required hydrogen was produced by the action of sulphuric acid (which the Navy had) on iron. He was thus enabled to effect several ascents.

TRANSPORT AND RAILROAD GAZETTE.

February 3, 1905.

TELEPHONES FOR TRAIN DESPATCHING (BALTIMORE AND OHIO).—After a conference of operating officers, this line has authorised its Superintendents to use telephonic orders for directing train movement wherever possible. A very complete system of telephones is installed, and one can understand that (under suitable rules, and presuming adequate arrangements for protecting traffic, *i.e.*, provided a Block or Absolute Timetable system exists) no undue element of danger need be introduced; but the note goes on to say that "the telephone is used exclusively for single-track blocking." This seems to imply that the element of safety obtained in arranging Meetings by duly recorded Orders is to be foregone. If so, this sounds like sacrificing safety to smart handling. From our point of view it is interesting to see that a telephonic system *can* be worked. Telephone or Phonophore might be of great use in arranging train movements on service, when it may happen that the telegraph line is blocked with urgent messages.

February 10, 1905.

RATE REGULATION AND RAILWAY CONTROL IN THE UNITED STATES.—The functions which are to be performed by the Interstate Commerce Commission in the future have come in for a good deal of discussion of late. The Commission, at the present time, has powers somewhat resembling our Board of Trade towards the Railways, but hardly so extensive, and can neither issue definite orders as to the system of working nor fix a limit of Rates. The tendency now seems to be towards conferring such powers, the underlying idea being the same as that which seeks to limit the power of the Trusts. Meanwhile, however, the writer of this article expresses the opinion:—(1). That legalisation of Pools will shortly be an accomplished fact; hitherto it has been maintained as a constitutional principle that competition should be unrestricted. (2). That further unification of the Railway systems must come about. If so, there is a great danger that the power thus gained by the parties in financial control of these big systems might be misused, and that eventually the result would be (3) Government ownership, with all its possibilities of political manipulation and illegitimate influence on the labour market. We must remember that the system of American Government makes it distinctly undesirable that such Government should embark on such commercial undertakings.

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February 17, 1905.

EMPLOYMENT OF FIREMEN.—By E. W. Pratt, C. & N.W. Railway.—Mr. Pratt urges the desirability of a proper system of registering men for employment on the principle "in time of peace prepare for war," so that there may be no difficulty in obtaining suitable men when the serious rush of traffic comes. He considers it important that the taking on of men should be concentrated at Divisional headquarters, and not simply left to local officials to do the best they can with what men they can get on the spot.

It is a little striking to read of men going through a "Correspondence course in combustion and Loco. firing" as a preliminary to entering the trade; and it shews how different some American methods of education are from ours. The author thinks it advantageous that men when taken on should at once get some acquaintance with shop and running shed work, and then learn the rudiments of firing on shunting engines, etc, so that they may be available to go out on the road on emergency.

He suggests that, when it is necessary to reduce strength, a "lay-off" list should be kept, the younger men being discharged first but given promise of re-employment. The C. & N.W. line has a regular scheme of first, second and third-year mechanical examinations, so that men may be encouraged to improve themselves technically. These courses have been found valuable to the Railway in reducing the number of burnt-out grates and such other failures as are caused by ignorance.

The writer does not, however, expect to get a really good class of man till mechanical Stokers are generally introduced, so that the fireman may be something more than a "Coalheaver."

C. E. VICKERS.

REVUE D'HISTOIRE.

February, 1905.

THE CAMPAIGNS OF MARSHAL SAXE, 1745.—The disposition of the two armies for the battle of Fontenoy is fully described, and is illustrated by a good map which does not, however, agree in all points with the text. The numbers of the two armies are said to have been nearly equal; French 47,000 present under arms, and Allies 51,000. But this does not take account of the French reinforcements (fully 5,000) which came up in the course of the battle; and it overrates the effective strength of the Allies. According to Ligonier, they had 46 battalions and 79 squadrons; and three weeks before, he had reckoned the battalions at 650 and the squadrons at 150, which gives a total of 42,000. The Austrian commander, Königsegz, reported the units as 48 battalions and 85 squadrons, perhaps including those which were left to guard the camp. In any case the superiority of numbers seems to have been on the French side. The story of the battle is begun, but not finished.

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THE CAMPAIGN OF 1794.—*Army of the North.*—This section deals with the Engineer organisation. The amalgamation of the French Artillery and Engineers, adopted in 1755, had been abandoned three years afterwards. There were many advocates of it in the first years of the Revolution, but the decision arrived at was that the two corps should be kept distinct, the Engineers being a corps of officers only, and the sappers and miners forming part of the Artillery. This was in 1790, but war experience soon showed the importance of giving special troops to the Engineers. The sappers and miners were transferred to them in 1793, and twelve new battalions of sappers were formed.

THE CAMPAIGN OF 1800 IN GERMANY.—The writer continues his discussion of the plans of operation, and shows that Bonaparte quite agreed with Moreau that Germany, not Italy, was the important theatre of war. He wished to go to Moreau's headquarters and direct the operations, though (as First Consul) he was excluded from the nominal command. Moreau, however, intimated that he should resign in that case; and he also refused to carry out any plan but his own. Bonaparte gave way, as he could not afford just then to quarrel with Moreau and make him a rallying point for malcontents; but he turned his whole attention to Italy. He could do as he pleased there with the more complaisant Berthier, and he drew off so many men in that direction that the campaign in Germany became subordinate.

SIDI-BRAHIM.—The effects of this disaster are shown, and the movements of the various French columns are described up to the junction of Cavaignac and Lamoricière, a fortnight afterwards.

E. M. LLOYD.

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RECENT PUBLICATIONS.

A Modern Campaign (War and Wireless Telegraphy in the Far East), by David Fraser, Special Correspondent to *The Times*. (6s. Methuen).

The Yellow War, by O. ($7\frac{3}{4} \times 5$. 6s. Blackwood).

God and our Soldiers, by Paul B. Bull, Chaplain to Cavalry Brigade in S. Africa. (6s. Methuen).

The Crisis of the Confederacy. A History of Gettysburg and the Wilderness, by Capt. Cecil Battine, 15th Hussars. ($9\frac{1}{4} \times 6$. 16s. Longmans).

Feldhandbuch für Truppenoffiziere, by H. Hoernes, Captain in the Austrian Infantry. (2.50 krs. Feichtingers Erben, Linz, 1904). (Pocket book on tactics for regimental officers in the field).

Marschtafel der deutschen Heeresteile, 1870–71, by v. Bornemann, Lieutenant in the German Infantry. (Gerhard Stalling, Oldenburg, 1905). (Consists of 4 pages tabulating movements of troops during the war).

Kriegsgeschichtliche Uebersicht der wichtigsten Feldzüge in Europa zeit 1792, by A. v. Horsetzky, Commanding 1st Austrian Army Corps. (20 mks. Seidel & Sohn, Vienna, 1905). (Condensed *résumé* of military history since 1792).

Die letzte Operation der Nord-Armee, 1866, by an Officer of the Austrian General Staff. (10 mks. Seidel & Sohn, Vienna, 1905). (Of historical value, describing the retreat in 1866, based on official records).

Wie studiert man Kriegsgeschichte? by Hoppenstedt, Major and Instructor at the Staff College, Potsdam. (1 25 mks. Mittler & Sohn, Berlin, 1905). (Interesting study of the battle of Elandslaagte, 1899).

Entwurf zu kampftechnischen Vorschriften für die Infanterie, by v. Schmid, Captain in the German Infantry. (1.20 mks. Bath, Berlin). (Suggestions on the vexed question of the Infantry Attack).

"*Seydlitz, den deutschen Reitern zugeeignet*," by Buxbaum, Colonel, Bavarian Cavalry. (Max Babenzien, Rathenow). (Fascinating sketch of the personality and exploits of Seydlitz, who is declared to be the "beau ideal" of a Cavalry leader).

Mémoires sur la Campagne de 1794 *en Italie.* (Publiés sous la direction de la section historique de l'état-major de l'armée), par Capt. Fabry. (5 frs. Chapelot, Paris).

Die letzte Operation der Nord Armee, 1866, *vom* 15 *Juli bis zum Eintritt der Waffenruhe*, bearbeitet von einem General staboffizier. ($12\frac{1}{2}$ mks. Seidel & Sohn, Vienna).

Le Blocus de Plevna; d'après les archives historiques, par Colonel Martinov, traduit du Russe par E. Cazalas. (Paris).

Stratagem, by Major C. G. Morton, U.S.A. (Hudson-Kimberley Publishing Co., Kansas).

Coast Defence. Handbook for Use of Electricians in Operation and Care of Electrical Machinery and Apparatus of U.S. Seacoast Defences. 2nd edition. (Washington).

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Waffenlehre (Schiesswesen, Handfeuerwaffen, Gebirgsgeschütze, Feldkanonen). (19 mks. Seidel & Sohn, Vienna).

Observations sur la Guerre dans les Colonies, by Lieut.-Colonel Ditte. (École Supérieure de guerre, Paris).

La guerre et le droit. Les Conventions Militaires dans la guerre continentale, by Emanuel. (4 frs. Lahure, Paris).

Instruction sur les travaux de Campagne à l'usage de l'Infanterie. (A. Fortification de Campagne. B. Travaux de Campement). (Offic. Suisse).

Wellington, Soldier and Statesman, by W. O'Connor Morris. (5s. Putnam's Sons).

Architecture East and West, by R. Phené Spiers. ($9\frac{1}{2} \times 6\frac{1}{2}$. 12s. 6d. Batsford).

The Timbers of Commerce and their Identification, by Herbert Stone. (7s. 6d Rider & Son).

Cements, Mortars and Concretes; their Physical Properties, by M. S. Falk. ($2\frac{1}{2}$ dols. M. C. Clark, New York).

The Metallurgy of Steel, by F. W. Harbord. (C. Griffin & Co.).

Fire Protection in Central Europe (Notes of Special Commission formed by the British Fire Prevention Committee), by E. O. Sachs, H. S. Folker and E. Marsland. ($11\frac{1}{4} \times 8\frac{1}{2}$. 5s. British Fire Prevention Committee).

Der Suezkanal; Seine Geschichte, seine Bau und seine Militärische Bedeutung. von Hauptmann Ungard. (5 mks. Hartleben, Vienna).

Leçons sur la topométrie et la curvature des terrasses (Professées à l'école des ponts et chaussées) par d'Ocagne. ($7\frac{1}{2}$ frs. Gauthier-Villars, Paris).

Earthquakes in the Light of the New Seismology, by Major C. E. Dutton, U.S. Army. (6s. Murray).

Cryptographie pratique, par de Grandpré. (3 frs. Boyveau, Paris).

Cities of India, by G. W. Forrest, C.I.E. ($8\frac{3}{4} \times 5\frac{1}{2}$. 5s. Constable).

Indian Life in Town and Country, by Herbert Compton. (3s. 6d. Newnes).

Adventures in Tibet, by Sven Hedin. (10s. 6d. Hurst & Blackett).

Le Trans-Sibérien (Railway), par A. M. de Koulomzine, traduit du Russe par Jules Legras. (5s. 8d. Hachette, Paris).

The East African Protectorate, by Sir Charles Elliot, K.C.M.G., late H.M. Commissioner for the Protectorate. (15s. Edw. Arnold).

The White Man in Nigeria, by G. D. Hazzledine. (10s. 6d. Edw. Arnold).

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*THE STRATEGIC EFFECT OF FORTRESSES AS ILLUSTRATED BY MILITARY HISTORY SINCE 1800.**

By T. MILLER MAGUIRE, LL.D.

THE art of fortification is as old as war itself, and is not confined to civilised communities. Our troops have experienced in every part of the world the fact that even savages see the importance of adding to natural shelter or protection artificial aids, whether of stones, earth-work or felled trees. Savages attain to considerable skill in this direction, and go so far as to provide flank defences as well as exceptionally strong works, such as New Zealand *pahs;* even the Red Indians throw up hasty entrenchments.

Among the civilised nations we see that fortresses at an early date assumed tremendous dimensions. Traces of these remain from the Danube and the Levant to Pekin. A large part of the history of China is connected with the Great Wall—the most stupendous of human undertakings, greater even than the Grand Canal of Kublai Khan. And the sieges of the towns in the Valley of the Euphrates, such as Nineveh and Babylon, as well as the sieges of Jerusalem, in ancient and sacred records, were epoch-making incidents. So again all through Grecian history sieges like those of Syracuse, of Tyre by Alexander the Great, of Carthage, and many an attack on Rome itself and attacks on Constantinople, not only by Russians and Mahommedans but by Christians, were noteworthy events.

Timour, or Tamerlane, destroyed all the principal fortresses from Seistan to Bagdad, Damascus and Smyrna, and made pyramids of the heads or living bodies of their defenders.

The Romans were masters of improvised fortifications and earth-works, as well as of the attack and defence of permanent fortifications. We see traces of their works at nearly every strategic point in Europe—from the mouth of the Danube to the Adriatic, and from Belgrade to the Tyrol, and all along the Rhine. We also see traces of their camps scattered all through England. Indeed I should advise any tactician in charge of manœuvres in any part of England

* Report of Lecture delivered *ex tempore* at the Royal Engineers Institute on 5th January, 1905. The lecture was illustrated by large wall maps, but it can be followed with the help of any good atlas.

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to look up the records of the Roman camps, and he will probably set perfect schemes if he adopts his offensive and defensive sites to the traces of Roman occupation. This was curiously exemplified in the manœuvres both of 1903 and 1904, particularly in the neighbourhood of Colchester, an old Roman camp.

When, after the chaos of the Dark Ages, the conquering races which had overwhelmed the Roman Empire began to settle down, we find all Western Europe studded over with feudal castles in commanding positions admirably situated for defence. Splendid examples of these are to be seen all along the Rhine, and they are immortalised by Lord Byron in his *Childe Harold*.

Very good examples are also to be found in the South of England; in fact one ruin is close by, viz., Rochester Castle.

Then again in the East, when the Saracens and Turks became masters of attack and defence, some celebrated sieges occurred, in which towns were defended by Christian knights, such as the defence of Rhodes, of Malta and of Jerusalem. And when the feudal system fell, artillery was introduced; the old castles gradually became useless, and quite new systems of fortifications were produced—permanent and improvised lines of defences; Villars' works, called the *ne plus ultra*, against Marlborough, are remarkable examples.

The defensive behind works introduced the mathematical system of the art of war, which spoiled the mobility of the armies in the 17th and 18th centuries. Observe how long it took Marlborough to get from Brussels to Lille. It was not until the French Revolution, bringing in a new power, compelled the French armies to break up and become divisions instead of integers that the true art of war was recognised. It teaches us that fortresses will not save nations; that they are very useful as delaying invasion, sheltering depôts, pivots for armies, covering armies, and as places to which armies can retire and from which they can advance with impunity. The true defence of the nation is the field army, and the more fortresses a nation has the more certain its ruin if it trusts to a merely defensive policy. Not walls, nor mountains, nor rivers, nor even seas can defend a nation; and if these cannot, certainly neither permanent works like Metz nor improvised works like Plevna, nor long walls, nor ridges and defiles can do so. Then what will save a nation? The manhood of the nation. As Lord Bacon says:—"Above all it conduces most for greatness that the breed and disposition of a nation be stout and warlike."

Fortunately for me your authorities very wisely narrowed the scope of my lecture to illustrate the effect of fortresses on strategic or grand manœuvres before and after decisive battles from history since 1800. They did not suggest that I should dwell upon the details of fortification or discuss the rival principles of fortification. We must

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take it for granted that each general and his engineers displayed, according to the resources at their disposal, a sufficient amount of skill; and that at each epoch the fortifications of each State were fairly up to date, as indeed they were both on the Continent of Europe and in America. Even as to Manchuria I have not heard from any authority that there are any grave defects, from the point of view of your engineering art, in the efforts of the Russians either at Port Arthur or at Liao-yang or on the Yalu.

It is said that the French fortresses in 1870 were not in as good a condition for defence as they ought to have been, but this was the fault of the Government and not of the engineers; and at any rate three of them—Strasburg, Metz and Paris—were of sufficient importance to cause all the German operations to be in the first place directed to their isolation and capture. Also in the American Civil War the generals on both sides displayed extraordinary skill in improvising fortifications all through Virginia and Georgia; and not only so, but they followed the example of the Roman legions and constructed fortified camps whenever they rested, and even put up some kind of hasty entrenchment during the progress of several battles. Similarly the Turks, at Plevna and other places during their struggle with the Russians, were not behindhand in the art of defence.

At present attention is being directed—and very properly directed—to our strategy in the North-West of India. I have shown that in Europe history in regard to the lines of invasion simply follows the roads of the Romans, and that we find modern works wherever a Roman strategic, decisive point was located. We also find that Alexander the Great attached precisely the same importance to Egypt, 333 B.C., as St. Louis attached to it in the 13th century and Napoleon in 1798, and as the British both when they sent Nelson to the Nile and in 1882 when they stormed the works of Tel-el-Kebir, and also as they attach to it now. So the lines of invasion and the fortresses, which led through Central Asia to the Indus and thence to Delhi, were precisely the same in the days of Alexander the Great (who thought he was following the example of Hercules) as in the days of the Moslem invasions. Timour discusses all of them in his *Institutes*. And both Akbar and Baber, emperors and conquerors, distinctly lay down that the keys of India are Herat, Kabul and Kandahar. Herat was founded by Alexander the Great. The Russian General Sobeleff has discussed our fortified position at Quetta, which he said could easily be turned into another Plevna, and Skobeleff proposed to imitate Timour's invasion with great hordes of cavalry.

These are far-reaching illustrations of the necessity for appreciating, seizing and preparing to defend well-known positions. And so long as discussions such as are now common as to the future conflicts and divergent interests of States in different parts of the world

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prevail, my audience of Royal Engineers need have no fear of its occupation being gone.

I will now show how particular fortresses influenced particular campaigns since 1800; and also that to trust to fortresses is a mistake, that the field armies should be kept away from them, and that they often prove a snare. It is also clearly proved that when invested they should always hold out to the very last, regardless of any humanitarian consideration. This is laid down by Napoleon and by Blucher, and in fact it is only common sense. What is the use of such expensive and formidable apparatus of defence, what is the use of engineers exhibiting ingenuity and a nation spending enormous sums of money, if the general in command at the particular moment surrenders before the works are half taken or the rations are all eaten? Any attempt to blend humanitarianism with war generally doubles instead of diminishes the misfortune of a country. There are cases in which even one day's delay might have saved a city—the relieving army was almost in touch with the fortress when it surrendered. The Archduke Charles says: "All that a great nation requires when it is invaded is time to develop its resources." It is the duty of the officer in command of a fortress to utilise the ingenuity of the engineer by making that delay as protracted as possible and the capture of his trust as costly as possible. It should also be remembered that the most elaborate systems of fortifications have been thrust aside or turned.

In 1800 Genoa was the last position left to the French by the Austrians and Russians of all the great conquests of Napoleon in Italy in 1796–97. It was invested by sea by the English fleet and by land by the Austrians. Massena was in command and he determined, to use his own words, to "eat his boots"; nor did he capitulate till his men and himself were reduced to the very last extremity. The eyes of all Europe were fixed on Genoa. Napoleon determined to defeat the Austrians, and it was generally supposed his objective would be Genoa, and that he would enter Italy either by the Corniche road between Nice and Genoa or by the Cenis Pass. Both were closed by the Austrian armies and the siege was vigorously pressed, but Napoleon recognised that if he could defeat the field armies of the Austrians it made little difference whether Genoa fell or not. Similarly, if the Russian forces defeat the Japanese in the field the fall of Port Arthur will not affect the final issue in the least. Napoleon therefore made a surprise march into Italy by the Great St. Bernard, reached Milan, and hurried over the Po by Piacenza to Marengo while the Austrians were concentrating at Alessandria. Now Massena just occupied the Austrian forces, which ought to have been closing the passages of the Po, a day or two too long at Genoa. The result was the battle of Marengo, the defeat of the main Austrian army and the recapture of Genoa.

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From the above illustration we can prove that it is often a good thing for a State to let a fortress go. But this is a difficult thing for a general to do; the people and the Press would make a great clamour if a fortress were abandoned to its fate, and it would require a Napoleon or some other person of commanding personality to take the responsibility. But the Archduke Charles in 1796 abandoned all Germany as far as Ratisbon, and kept on retiring until he found it convenient to make a counter stroke. In 1805 Ulm proved a trap to the Austrian General Mack, who held it too long, till Napoleon and his marshals converged from the Maine and Rhine, isolated him, and took him prisoner. Then there was not a sufficient field army between Napoleon and Vienna, which he entered with ease. In 1809 the effect of fortresses on a parallel river was felt by Napoleon; for, as he advanced from the Danube to Vienna, he was obliged to detach troops all along the Danube—at Passau, Linz and Krems; and accordingly, when he reached Vienna and found he was threatened on the north bank of the Danube at Essling, he had too few men for his purpose.

This leads us to another consideration—that the proper way of defending a capital is by relying not on fortresses or defensive positions astride the enemy's path so much as on the fortresses or entrenched positions on the flank of his path. We will see this well illustrated when we come to France in 1870.

In 1806 Napoleon's objective was the field army of the Prussians. He, therefore, immediately after beating them at Jena and Aeurstadt (Oct. 14, 1806) ignored Magdeburg and the other forts and went straight into the unfortunate capital Berlin. Before the field armies could recover themselves Prussia was crushed.

In the campaign against Russia in 1812 there were, after the great battle at Borodino, practically no fortresses except Smolensk to protect the Russians, who drew the enemy into the heart of the country, into their own ancient capital which they burned themselves. The Russian army was then put on the flank of the invader, who had to retreat with enormous loss. In the campaigns of 1813–14, when Napoleon was retiring from the Oder and Elbe across the Rhine to his last great stand between Vitry and Paris, the pursuing Russians, Austrians and Germans ignored the fortresses; and although the allies were in France, curious to say a very considerable number of French soldiers were holding fortified positions in Germany. On the other hand it is very probable that, if Paris had been fortified in this campaign, Napoleon's resistance would have been prolonged; but there was scarcely any chance of its being successful even then except through dissensions among the allies; he would not have been successful from a strategic point of view.

When celerity is an object, fortresses will often determine the choice of the plan of operations. Napoleon in 1815 was in a hurry

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to interpose between the Prussians and British, and consequently he did not advance by any road where there was a delaying fortress such as Mons, Tournay.

A certain school of military writers in England seem to have imagined that, because an officer belongs to a race which was the first to apply the true principle of artillery in Europe, and which has done more fighting for a longer period with success than any other European race except the Romans, he cannot possibly be worthy of providing them with sufficient material for thought in the present or that his performances in the past can be of any value by way of instruction for the future. It may therefore be a surprise to some that I propose to quote the operations of the British in Spain and Portugal as giving admirable lessons both in defensive and offensive warfare, the skilful use of the command of the sea, masterpieces of improvised works, as well as desperate assaults and successful enterprises against permanent fortresses. I must not give my own opinion, as it might seem prejudiced; but if any of you will at your leisure consult General Veal, you will see that, in the opinion of the authority at St. Cyr, Wellington's defence of Portugal, his use of fortresses on the frontier, his skilful abandonment of fortresses, his retirement, deceiving Massena into the belief that he was going to evacuate the country, his elaborate lines of Torres Vedras (covered on each flank by sea power and invulnerable in front) are the best possible methods of defending a country which is determined to resist *à outrance*. And then, when Massena was exhausted before the works, Wellington's advance is regarded as an admirable illustration of defensive-offensive operations, securing the entire deliverance of Portugal.

Strange to say Russian records prove to us that the Tzar Alexander I. urged upon his generals the immediate adoption against Massena's master, Napoleon, in 1812, of the plan which Wellington followed in 1810–11; and Kuropatkin's withdrawal from the Yalu to the Sha-ho, and the retreats of Jackson in Virginia and of Johnston in Georgia in 1864, are based upon principles of which Wellington was the very ablest exponent. I have been trying for twenty years to induce our authorities, while carefully culling information from every other national history, to encourage our own soldiers by impressing upon all instructors the necessity of doing what Sallust advised the Romans to do—"Seek for examples of heroism among men of their own race." Therefore I make no excuse for taking some of my illustrations from the Peninsula.

In the first months of 1812 the French military system in Spain, which involved making war support war or living on the country, caused their Corps to be scattered; but their front as regards Portugal was covered by two fortresses, on the north by Ciudad Rodrigo and on the south by Badajos. These commanded the only roads by

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which armies could conveniently enter Spain. Wellington resolved to break the French front and to take these fortresses at all risks before they could be relieved by the covering armies. He first stormed the northern fortress at great loss of life, and then the southern in the most sanguinary scene of the long revolutionary wars—the most terrible assault between 1793–1815. He precipitated the assault to gain time. He was severely blamed for his lack of humanity; but he was easily able to prove that, if either or both of the Marshals had come to the rescue of the fortress, to have beaten them off would have probably cost even more men, and if they had relieved the fortress the war would have been protracted over a whole year.

A similar answer, I believe, would be given by the Japanese, who are now making such desperate assaults on Port Arthur. They have no desire to kill their soldiers, but time is of the utmost importance to them. If Wellington in 1812 and the Japanese in 1904 were not prepared to take the enemy's works at all costs, it was only trifling with their interests to detach troops to invest them; it would have been much better simply to have watched them.

Now these successes of Wellington in January and April, 1812, were the foundation of all his future victories. It gave him a fortified frontier to fall back upon in his subsequent retreat in the same year, and it gave him a fortified post from which to advance in his brilliant advance of 1813. But when he advanced in 1813 from Salamanca as far as Burgos, he found his line of communication too long and the supply of transport scarce. Accordingly he did what the Japanese have done and what the American Federals did; he used his sea power to cover the flank of his advance. He transported his base from the mouth of the Tagus and Douro to the northern Spanish coast at Santander, where he was supplied from his left. Thence he ventured on, and the French had to retreat step by step, across rivers, abandoning positions, in deference to his turning movement; just as Kuropatkin was obliged to move off, lest he might be nipped by Oku on his right and by Kuroki on his left, so King Joseph was forced to retire from the Ebro to Vitoria, where he was defeated on his front, turned on his right, cut off from his main road to the fortress of San Sebastian, and driven to retire in tumultuary manner (losing 151 out of 152 guns). Kuropatkin is not in so bad a case just yet.

The Peninsular War had been going on since the summer of 1808; and in June, 1813, Wellington, on the one hand, determined to invest the frontier fortresses of San Sebastian and Pamplona, and Soult, on the other hand, who took the place of the unfortunate King Joseph (a general to whom his brother the Emperor was always inditing strategical and tactical lessons in vain), determined not only to protect the two fortresses but to turn the tables on the English by relieving the fortresses, breaking their front, and beating them

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on the plains of Vitoria. This he might have done but for the British command of the sea and for the ability of Wellington in mountain warfare. Wellington says he could not, except for the aid of the Navy, have taken San Sebastian at all, or moved up his base from San Sebastian to Bayonne. On a small scale San Sebastian was extremely like Port Arthur; it was on the left flank of an advance into a Continent from a Peninsula, and it promised to provide a harbour to the British on an inhospitable coast. Of course the tonnage of vessels then was very different to what it is now. The British transports were only about 500 tons, whereas ships of the present day have twenty times as much tonnage; and some of you went out to South Africa in vessels that would carry a very considerable portion of the whole British Army that landed in the Peninsula in 1808. Soult now defended the South of France by a series of works, described by Napier, which delayed the British from August to December before they could get to Bayonne. He then retired to the fortress of Toulouse, and the enemy could not take it till April, 1814.

My time presses and hence I must hurry on to America. Vicksburg, on the Mississippi, cut the Northern forces at New Orleans and at St. Louis and Cairo in two. It had to be taken, and this compelled the Federals to spend an enormous amount of ingenuity and money in 1862–63. I have already referred to the improvised works during the American Civil War. But Lee understood the true use of fortifications—not merely to exhaust the energy of the attack on a purely defensive system, but also as a pivot for offensive manœuvres. From the works on the Rapidan, near Chancellorsville, in 1863, he allowed Jackson to sally forth to turn Hooker's right; at Richmond he delayed Grant from the middle of 1864 to April, 1865; and as his last avenue of escape was well nigh closed, he went out and was only compelled to surrender by a combined attack by Grant and Sheridan at Appomattox. There is not the slightest doubt, as Colonel Henderson has proved, that the Confederates, although their armies were improvised, made more skilful use of works than most of the regular armies of Europe have done.

The history of the Crimean war is practically a story of how Todleben not only improvised the works at Sebastopol but skilfully held them for a lengthened period, thus preventing any inroad on the main lines of Russia; and he ultimately evaded the Allies, notwithstanding their naval and military superiority in the Crimea.

The importance of a flank position of a permanent character and well held is shown in the Franco-German war. Strassburg obliged 60,000 men to be detached after the battle of Worth from the main body of the Germans; and in spite of the splendid successes of Borny, Rezonville and Gravelotte, the German advance on Paris was rendered risky by the defence of Metz, which caused the detention of

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240,000 Germans. If MacMahon had retired to the southern flank, where there were ample supplies, and played a waiting game, and collected together the reinforcements which afterwards joined, in all probability the investment of Paris would not have taken place for a considerable time later. But MacMahon made a flank march to the relief of Metz, which ought to have been left to its own resources for weeks at least, in such a fashion that he was skirting the frontier, thus giving the Germans a chance of causing him to fall back on the old fortress of Sedan, which, like Metz, proved a trap; the result was fatal to the regular armies of France. On the other hand, in justification of the Archduke's remarks about the delaying power of fortresses, every day that Metz and Paris held out was increasing the probability of a German disaster. The situation of the Germans on the Loire and on the Somme was only saved by the fact that the fall of Metz released a number of German Corps, which spread themselves out towards Besançon, Orleans, Le Mans, Rouen and Amiens and, by preventing the possibility of relief, caused the fall of Paris through starvation.

I am no advocate for trusting to fortresses; no more are the Germans, who have now few forts compared with France. But an army on the flank of an enemy which is invading can never be ignored, and if it is in a strong position it will be a source of danger.

Kars, in point of fact, blocked the way to the Russians into Asia Minor, but Plevna was a surprise. After they had passed the Danube at Simnitza-Sistova they were quite prepared to have to detach large forces to their left before crossing the Balkans; they were prepared for a detachment in the direction of the well-known quadrateral, the fortresses of Varna, Shumla, Silistria and Ruschuk. When they took Nicopolis they considered the roads over the Balkans to Adrianople safe. But Osman Pasha improvised earthworks round the little town of Plevna, and kept them so occupied that at last, after many unsuccessful assaults, one costing 18,000 men, Todleben resorted to investment, and, like Lee, the brave Turk, after his resources were exhausted, tried to escape in vain. However, it is not easy to conquer a determined race, whether they dwell by the shores of the Bosphorus, or by the shores of the Channel, and the Russians found the Turks exactly imitated Wellington in the south of Portugal. Having the resources of Asia Minor behind them they covered each flank of a position about forty miles north of Constantinople, called the lines of Buyuk Tchekmedje. Even as Massena was foiled by Wellington, so the Archduke Nicholas was foiled by Mehemet Ali. The Russians could not force the lines; their army was completely exhausted; provisions were scarce; the country back to the Danube was completely devastated, as was Portugal in 1810. Sea power they had none, because, to complete their difficulties, the British Fleet, under Admiral Hornby, had seized

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upon San Stefano. They had no medical supplies nor comforts; at least 30,000 out of 80,000 were unfit for duty through enteric. In fact Kuropatkin's men at Sha-ho were incomparably better off than were the Tzar's men in front of Constantinople.

This again shows the strategic importance of fortresses, if a nation is resolved to hold out and if they are used as snares or traps. If Osman Pasha had only retired south a couple of months sooner, there were other flank positions which would have so opposed the Russians that in all probability they would have been glad to retreat.

Thus, without going into details, I have illustrated to you the importance of a proper application of your art in all parts of the world—from Palmyra to Acre, from Constantinople to Paris, from St. Louis to New Orleans, and from Vicksburg to Savannah.

In conclusion I cannot refrain from expressing my hearty appreciation of the honour conferred on me in being allowed to occupy such an excessive amount of the time of a Corps which, under the proud motto of "Ubique," has illustrated the annals of permanent and field engineering, not only in the Iberian Peninsula by works rivalling those of the Roman Emperors, but in almost every part of the civilised and uncivilised world over which floats the banner of St. George.

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AERONAUTICS IN AMERICA.

By Bt.-Lieut.-Colonel J. E. Capper, c.b., R.E.

The Managers of the Louisiana Purchase Exposition held at St. Louis, Mo., U.S.A., had offered very considerable rewards for operators and inventors who should prove successful in a variety of Aeronautical contests, viz. :—

(1). Racing over a triangular course in the air with a Flying Machine or Dirigible Balloon under certain conditions of minimum speed and distance.
(2). Ascending in any form of Flying Machine, Air Ship or Balloon, and descending safely closest to any named spot.
(3). Ascending in a free Balloon and making the longest journey in any direction before again reaching the earth.
(4). Flying a Kite to the greatest altitude, such altitude to be not less than 1 mile above the ground.
(5). Producing a Kite which, when flown with a given length of cord, would fly more steadily and at a greater angle with the horizon than other kites.
(6). Producing a Motor which would run satisfactorily during a ten hours test, and would prove lighter per B.H.P. than any other motor which passed the test.
(7). Producing a Gliding Machine which would carry an operator and behave best during a series of glides over a certain minimum distance.

There were also Rewards offered for flying machine models controlled from the ground, but not in any way attached to the ground.

It was hoped that the large Rewards offered, together with the amount of advertisement that success in these various contests would entail, would attract to St. Louis representative aeronautical talent from the whole of the civilized world, and also stimulate very largely the efforts being made in various parts of the globe to obtain control of the air, and increase and popularize knowledge of this most important subject.

The jury determining the results of all the contests was to be International in character, and an International Aeronautical Congress was also to be held at St. Louis during the early days of October.

I was deputed by the War Office to visit St. Louis, with the object

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of examining, and reporting generally on, the aeronautical exhibit and ascertaining what progress was being made in aeronautics generally.

Before leaving England I was, through the courtesy of Mr. P. Y. Alexander (a gentleman who is probably better acquainted personally with all interested in aeronautics in Europe and America than any other living individual), given a number of letters of introduction to various gentlemen who are interested in Aeronautics, and whom I might hope to see in St Louis or might visit if they lived within reasonable distance of my route.

Among these the most prominent are :—Mr. W. J. Hammer, New York (Flying Machines); Mr. O. Chanute, Chicago (Gliding Machines, and author of works on the Flight of Birds, etc.); Messrs. W. and O. Wright, Dayton (Gliding and Flying Machines); Professor Langley, Washington (Flying Machines); Professor Marvin, Washington (Kites: Air conditions: Self-registering Meteorological Instruments); Professor Manley, Washington (Flying Machines and Light Motors); Professor Zahn, Washington (Air Resistance and skin friction of bodies moving through the air).

Among the Aeronautical World at St. Louis I met:—Major Baden-Powell (President Aeronautical Society of Great Britain); Eugene Federoff (President of Aeronautical Society, St. Petersburg); Capt. von Tschudi (Instructor of Aeronautics and Wireless Telegraphy, German Army); Professor Nipher (Washington University, St. Louis; an authority on Air Pressures); Mr. W. Amery (Practical Experimenter in Gliding); M. Hippolyte François (Inventor of a Dirigible Balloon); Mr. W. F. Eddy (Inventor of a system of photography from above by means of a camera attached to a kite).

AERONAUTICAL EXHIBITS AT THE EXPOSITION.

Apart from the Contests, there were few exhibits in the Exposition of interest to the Military aeronautical world.

American Section.—In the American Section was an exhibit by the Smithsonian Institute of Professor Langley's Flying Machines. One machine was a model which actually made several flights; one flight was nearly ¾ of a mile, when the machine fell, uninjured by the fall, on the motive power ceasing to act. The second was a model of a full-sized machine made by the Smithsonian Institute; this machine was twice tried, and on each occasion came to grief at once owing to defects in the launching apparatus. The general structure of these machines, which are very complicated, is well known. The engines mounted on them are wonderfully light, but were not on exhibit.

There were also some light self-registering instruments suitable for use in balloons and kites. These are designed by, and made for, the Meteorological Bureau at Washington.

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German Section.—The German exhibit included a spherical balloon and a model of a kite balloon ; also what appears to be a valuable system of map-making by means of photographs taken from a balloon.

The photographs are taken by a camera fixed to a horizontal rifle-shaped arm fitted with a spirit level. The camera is set to a definite fixed angle with the axis of the rifle. The magnetic bearing of the line of sight, and the barometric height at the time of taking the photograph, are noted. The sight is pointed at some definite object in the centre of the piece of ground of which a map is required ; and when the spirit level is horizontal, the trigger of the rifle is pulled, taking an instantaneous photograph. The process is repeated later from a point at a distance from the position where the first photograph is taken. From the two photographs so taken co-ordinates are obtained from which the position of definite points are plotted. The result as exhibited was a contoured map, about two kilometers square ; and it was claimed that the accuracy of the map, both as regards plan and heights, was wonderful. If the system is practicable, the results may be of the highest importance for obtaining contoured maps of ground inaccessible from any position we can reach.

Another exhibit of interest was a model of the apparatus used for winding in long lengths of wire on a drum without unduly compressing the drum.

There was also a fine collection of self-registering barometers and thermometers ; articles in which we are very deficient, and which we ought to have constantly at work both when working captive balloons and on free runs.

BALLOON PHOTOGRAPHY.

Practically the only exhibit was that noted above. I could find nothing specially likely to be of service in the way of cameras, or of rapid means of developing and printing enlarged photographs by any method that would be of use in the field. Where considerable appliances were available, as might be the case in a siege, photographs were very rapidly developed, and the printing was done instantaneously by means of a flash of the "Westinghouse" electric light.

BALLOON MATERIAL.

None of the balloons at the St. Louis Exposition were made of skin.

German Spherical Balloon.—The German spherical balloon shown, used for free runs only, is of cotton, varnished. It is said to be fairly gas tight and to have gone for more than 40 runs.

It has an ordinary valve to let out gas as required, and a tear valve for use on landing. The latter consists of a special strip sewn into the

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balloon from top to bottom; when necessary this strip is easily torn right down by a thin cord, deflating the balloon at once. No grapnel is carried; when a descent is made the cord of the tear valve is held in the hand, and jerked hard at the moment of landing; the car has its one bump and then stays in position. There is no doubt that the danger of landing in high winds is much decreased by the use of this valve, as the balloon never drags after touching the ground. On the other hand, accidents have occurred owing to the valve being torn at a height from the ground, bringing the car violently down and damaging the aeronauts.

German Kite Balloon.—A model of the German kite balloon was shown. This is made of two thicknesses of cotton fabric with rubber between. The Germans seem satisfied with it as a fabric. The outside is painted a bright yellow; if this is not done the action of sunlight on the rubber vulcanizes it, and the rubber cracks, rendering the balloon leaky.

I gathered that the Germans are not quite satisfied with their kite balloon. It takes a large number of men to manage it, and a great deal of gas to fill it. They would readily abandon it for a spherical balloon on calm days and kites on windy days, could they get a satisfactory system of man-lifting kites.

American Balloons.—The United States Army had no exhibit of balloons. When required they get them from a private manufacturer.

I saw some of the material, and one balloon said to have been used in the Spanish-American War. The fabric is of silk; it is passed through a bath of pure boiled linseed oil, and then through heavy rollers which express all but a minute quantity of the oil. This process is repeated twelve times; at the end of this the fabric is said to be gas tight and lighter than when hand varnished. If not wet when folded up it does not stick, nor heat. I saw a quantity, kept wound on a roller, which was neither stuck nor heated. I doubt whether the fabric is gas tight, though holding fairly well.

HYDROGEN GAS-PRODUCING PLANT.

The hydrogen gas used in the Exhibition was mostly produced by the Newton-Lane process, a plant having been sent out from England for the purpose.

The plant as exhibited consists of three boilers side by side. The steam generated in each boiler can be led into a steam pipe, or passed down through the furnace of the boiler. The boilers are lighted with coal, draught being at first furnished by an auxiliary boiler driving a fan. As soon as the boilers produce sufficient steam the auxiliary is cut off and the boilers furnish their own draught.

The water gas, formed by passing the steam down through the furnace, is led by an underground pipe to a scrubber, where it is

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cleaned, and thence to an oven in which are six retorts filled with cast iron shavings. It is lighted and used for heating up these retorts to a white heat. When these retorts are at the correct heat the steam from the boilers is passed into three of the retorts. In its passage over the white-hot iron the steam parts with its oxygen, which forms an oxide of iron, whilst the hydrogen (probably mixed with some water vapour) passes out through another scrubber to the gasometer or wherever required. After a little while the iron shavings become coated with oxide, and will not take up more oxygen. The steam is then turned off and passed through the other three retorts, whilst those in which the oxide has formed are being regenerated by passing a portion of the water gas through them, the gas after passing through the retorts returning to and mixing with that being used to heat them on the outside. It is claimed that the iron oxide is thus again converted into metallic iron, the oxygen combining with the carbon and hydrogen of the gas to form water and carbon monoxide.

The plant takes some hours to heat up before it is available for use; but when running well it is said to give off 100,000 cub. feet of hydrogen of good quality in 24 hours, at a cost of about 50 cents (2s.) per 1,000 feet. The labour required to run it is, for each relief, 1 engineer, 1 driver and 3 stokers. The coal consumption is from 2½ to 3 tons per diem.

It was not running satisfactorily while I was at St. Louis. It was left in charge of a young American mechanic who did not properly understand it, and who had no idea of the chemical process involved; and the men under him were ignorant people who could not be trusted to look after the simplest piece of machinery. The consequence was that bearings were always heating and something going wrong. Finally the retorts got out of order and would not make gas; and I heard that, after I left, a mixture of gas and air took place, was lighted, and wrecked the whole apparatus.

The chemical portion of the plant did not commend itself to a distinguished English chemist, owing to the action of the gases on the retorts and to the extreme difficulty of judging the correct temperature of the iron shavings so as to get them to the proper heat without their melting. I am of opinion, however, that the process is worthy of further examination; it can, I understand, be seen at Manchester. The preliminary cost is not great, there being no special machinery involved. The cost of working is also small, being merely that of a few tons of coal per 100,000 cubic feet and the labour required, which is not excessive and very little of it specially skilled. The cost of compressing would be less than at present, owing to continuous work on the compressor being possible; and it should be possible to reduce the cost of hydrogen to that of coal gas.

There were no means available of testing the purity of the hydrogen produced by the process at St. Louis, but the smell was

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distinctly less offensive than that of most hydrogen produced from zinc and acid, and the lifting power appeared to be very fair.

DIRIGIBLE BALLOONS.

Baldwin's.—The show of dirigible balloons was very poor. At the time of my arrival there were two. One belonged to a Mr. Baldwin, and consisted of a small cigar-shaped envelope of varnished cotton, carrying a frame of Santos Dumont type ; it was furnished with a stern screw, driven by a small petrol motor of ordinary construction. Though frequently going to ascend it did not do so whilst I was at St. Louis. I heard it had done so after I left. The President of the British Aeronautical Society, who saw it, informed me it did what might have been expected of it, *i.e.*, it could go on a calm day about 6 miles an hour. It was unable to stay in the air for more than a short time. It showed no progress whatever.

Benbow's.—Another, shown by Mr. Benbow, was also a cigar-shaped envelope of poor construction, holding hydrogen fairly well at atmospheric pressure, but not capable of holding it under greater pressure and unfit to stand any considerable internal strain. The envelope carried a small framework, made of bicycle tubing, which held the aeronaut, engines and propellers. These propellers are of novel construction, being paddles so arranged as to beat the air on the downward stroke and fold up on the upward. The arrangement is ingenious, but of little practical utility. Originally there were two pairs of paddles, driven by a belt drive from a motor ; but the envelope proved incapable of lifting so great a weight, and the weight was therefore reduced by altering the arrangement so as to have only one pair of propellers working amidships.

This balloon also I could not see in the air ; but I was informed that it ultimately made a short ascent, on a very calm day, and succeeded in progressing at about 3 miles per hour, proving of no practical utility.

François'.—The only dirigible balloon to be seriously considered was one brought over from France by M. François, who had really studied his subject, and understood at least what he was trying to do, though possibly mistaken in his calculations. This balloon arrived on the scene very late, and owing to one delay after another the whole was not ready for filling until shortly before I left. Finally there was a hitch over the gas-producing plant, and when this had been got over the plant itself was wrecked by an explosion. I have heard that all attempts to fill the balloon were ultimately abandoned, so that it has not had a trial at all.

The gas bag is about 50,000 c. ft. capacity (I could not get the exact figure), of good construction—an elongated spheroid in shape. It is furnished with suitable valves and ballonet. Suspended from

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the centre portion is a stiff wooden framework carrying aeronauts, motor, propellers, etc. The main framework or car is about 8 ft. long by 4 ft. wide, with extensions to front and rear so that the suspension ropes may bear over a greater length of the envelope, and branched upwards and outwards to carry the screw propellers.

The motor is a 25 to 28 B.H.P. 4-cylinder petrol motor, weighing with fly wheel 270 lbs. stripped. It is carried on two girders in the floor of the car, and is water cooled. Extensions of the car downwards protect it from hitting the ground.

Propulsion is obtained by means of a pair of fans on either side of the car. These fans are driven by belt drive off the main shaft of the clutch, one belt being twisted so that both pairs of fans revolve inwards. The fans are formed of bicycle tube framework, broader at the tip than at the base, set at a pitch of about 18°. Each fan is two-bladed, the front fans 3 meters and the rear fans 4 meters from tip to tip. Front and rear fans on the same shaft are about 10 ft. apart, and the blades on the front are perpendicular to those on the back. The blades of the fans are covered with canvas, those on the front fan for a distance of one-third their length from the tip, those on the rear fan for one-half their length.

M. François claims that by his method of making the front fan smaller than the rear fan, he, as it were, forces the air passing through the fans to keep a conical shape, and thus attains great horizontal stability.

I could not ascertain (not having seen the balloon in the air) what method he used to ascend or descend. There was no apparatus fixed to his car to enable him to go up or down, and he hinted that he must keep something secret. It is probable that he works it by inclining the balloon slightly by altering his position or that of his assistant.

Turning in a horizontal plane is effected by altering the speed of the screws on one side or the other, as required, by means of friction pulleys, which are forced down on to the driving belts by weights and springs and can be lifted by pulling on ropes from the car.

The whole apparatus is well constructed; but whatever are the merits of this balloon, it is still rendered comparatively useless by the gas bag, which cannot stand any great internal strain and so must let out gas when the pressure inside increases, thus entailing the forcing of air into the ballonet in order to keep the form of the balloon and the throwing of ballast to compensate for the loss of gas. When all ballast is expended the balloon must soon come to the ground.

M. François claims a speed of 18 meters per second for his balloon; but, as that amounts to 40 miles per hour, it appears excessively doubtful whether he can attain anything approaching that speed.

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KITES.

There was nothing of particular interest in the kites exhibited.

Competitions took place on three days for kites of any kind. The most numerous entries were of the pattern known as the Malay or Eddy kite, an improved pattern of the old flat triangular kite.

There were several triangular box kites, with the base of the triangles broadened out and connected outside the frame of the kite so to form horizontal wings; and a similar one with the addition of a fin at the back. Two very light Hargreave box kites, covered with Japanese paper, were also flown; and Baden-Powell's hexagonal flat kite.

The Hargreave kites exhibited their superiority as regards stability, ease of raising, and lifting power. The Eddy kites were stable but had little lift. The triangular ones had considerable lifting power, but were very unsteady. The Baden-Powell kites were difficult to raise, but appeared to do well in a stiff breeze; unfortunately they broke away.

Graham Bell's multi-cellular kite was not in for the competition, but flew well on one occasion when exhibited. It is, however, a difficult and lengthy operation to put it together, and it is bulky to transport; it is therefore useless for military purposes.

GLIDING MACHINES.

Notwithstanding the prizes offered for gliding machines, there was only one entry—a beautifully constructed double aeroplane of Mr. O. Chanute's.

Mr. Chanute informed me he did not anticipate much success, nor did the machine meet with much. The ground allotted was most unsuitable, being a small oval with buildings on one side, raised seats to a height of 25 feet on the other, and high trees behind; the result was that the wind currents near the ground were deflected in all directions, and there were numerous downward currents which would strike the glider on the top and force it rapidly to the ground. Gliding can be properly practised only from the top of a gently sloping hill against a current of air rising up the slope of the hill. This rising current sustains a good glider, and enables it to stay in the air during the duration of the glide.

Mr. Chanute tried a novel means of gliding. The operator (Mr. W. Avery) stood on the ground with his arms resting on the lower portion of the glider, which he carefully balanced. Attached to the front of the glider was a long cord, connected at the far end to an electric winding engine. On the engine being started the cord was rapidly wound in, the operator running along the ground till the speed was sufficient to raise the glider like a kite. When at a

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sufficient height the cord was loosed by the operator, and the free machine glided to the ground.

I saw a good many attempts, but never saw a really good glide; probably the pace was insufficient for the machine to glide properly. The best I saw was about 90 feet from a height of some 25 feet in the air. The operator at times allowed the machine to go higher, but I did not happen to be present at those times.

The method adopted was one that might advantageously be used to train operators to work such machines, but is not without danger. The descents were at times rapid, and shook the operator very considerably; finally he sprained his ankle badly and the experiments were abandoned.

PROF. ZAHN'S EXPERIMENTS ON AIR RESISTANCE.

At Washington I visited the laboratory of Professor Zahn at the Catholic University. Mr. Zahn has carried out a long series of most useful experiments on the resistance offered to currents of air by bodies of different shapes. This is a subject which is of the highest importance in determining the best shapes to give both to dirigible balloons and to any form of flying machine. He has also ascertained by his experiments the amount of skin friction of numerous bodies of varying shapes and different materials.

The experiments, though of the greatest utility, have been far too limited for any but general results to be arrived at; but his work can at least teach us a good deal that has to be avoided.

When it has been determined, as it has been, that at a speed of 20 miles an hour the scientific design of a dirigible balloon, or even of the car, may reduce the total resistance of the air against it by 50 or even 75 per cent. of the resistance against an unscientifically designed apparatus, the importance of such experiments can be readily understood. One of the chief obstacles to be overcome with a dirigible balloon is the enormous air resistance at high speeds. A comparatively small amount spent on such experiments may result in the saving of large sums of money expended on the construction of a full-sized air ship, the design of which is wrong in principle.

In the design of water ships at the present day numerous experiments are made, as regards water friction and wave action, by trying large numbers of models under various conditions of speed before the lines of any new ship are decided on; and this system of actual trial of models is equally important in the case of air ships, where the reduction of head resistance and skin friction is a necessity for success.

Incidentally Mr. Zahn has carried out a few experiments on the resistance of birds' wings, especially of a buzzard mounted in the position the bird takes in soaring flight, and he has ascertained that

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the total resistance is wonderfully small compared with the cross section of the bird and its wings.

PROF. LANGLEY'S FLYING MACHINE.

Another visit paid at Washington was to the Smithsonian Institute, of which Prof. Langley is the head.

The trials made with a model flying machine and, after its successful results, with a full-sized machine manned by Mr. Manley, are well known. Mr. Manley is confident that success would attend their efforts were further funds available. The U.S. Government spent 10,000 dollars on the trials, and have apparently decided to spend no more, at any rate for the present.

In both cases where the full-sized machine was tried it dived headlong into the water, and in both cases this result was almost certainly due to slight defects in the launching apparatus. Unfortunately, after the second accident, the salvors, being ignorant of the delicacy of the structure, damaged it so badly that great expense would be entailed by making it again, so that the machine is still unrepaired.

Though the machine is one of great interest, and may under favourable circumstances be induced to fly, and is doubtless susceptible of management in the air, the launching methods require so much mechanical apparatus that the machine can only be started from the particular place or places where such apparatus exists; its usefulness is thus very seriously limited.

One great feature of the apparatus is the engine, 50 H.P., said to weigh less than 3 lbs. to the H.P. The design of this engine was kept secret until recently, when the Smithsonian Institute determined to show it at the St. Louis Exhibition. Unfortunately the motor tests there were abandoned, but not until the machine had been dismantled and packed for transit; it was still in its cases when I was at Washington, so I had no opportunity of seeing it. It is said to be extremely noisy, and this would make it somewhat unsuitable for a military scouting machine, which cannot desire to advertise its presence.

It appears unlikely that anything will be done to further this machine for some time, nor do I think it advisable to work on its lines. It is delicate, complicated, and both expensive and difficult to construct.

WRIGHT'S FLYING MACHINE.

At Dayton I visited Messrs. O. & W. Wright, who have for the past five years been carrying out experiments there.

If the work they are doing is carried to a successful issue, we may shortly have, as accessories of warfare, scouting machines which will

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go at great speed and be independent of obstacles of ground, whilst offering from their elevated position unrivalled opportunities of ascertaining what is occurring in the heart of an enemy's country.

GENERAL SUMMARY.

As regards aeronautics I have the following general remarks to offer on my American experiences :—

Captive Balloons.—We can learn little or nothing in America as regards the construction, material, and management of Military Captive Balloons.

Dirigible Balloons.—There is no sign at present of America coming to the front in Dirigible Balloons. France and possibly Germany are making progress; but there is still much to be done in this line, especially in the designing of shapes and screw propellers best suited to give good results against the resistance of the wind, and in perfecting arrangements to allow of considerable variations of altitude without expenditure of gas and ballast.

Flying Machines.—England is very backward. There are strong hopes of success in this direction, and such success, with at any rate small machines, may come much earlier than is generally anticipated. America is leading the way, whilst in England practically nothing is being done.

Kites.—I saw nothing in any way equal to the "Cody" kite.

Meteorological Work.—Our Government affords but little assistance to work done for the study of atmospheric conditions, air currents, etc. Whilst the importance of a thorough knowledge of these in order to safely navigate the air must be admitted, in the same way as a knowledge of the sea and its tides and currents is necessary for the successful sailor, the British Government affords but little assistance. America and most of the great European nations take active part in such experiments; with us it is almost entirely due to the efforts of private individuals that anything at all is done.

In conclusion I wish to record my appreciation of the very general courtesy and kindness I met with during my visit; and of the generous manner in which the results of experiments, made often at considerable cost and with infinite patience, were placed at my disposal.

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SEWAGE DISPOSAL WORKS AT DEEPCUT, NEAR ALDERSHOT.

By Lieut. G. C. V. Fenton, R.E.

These works have been constructed to dispose of the sewage from barracks built for two brigades of Royal Field Artillery. The barracks accommodate 1,000 men and 550 horses, and contain the usual complement of married quarters and accessory buildings. The works comprise a silt pit, two settling tanks, and a series of filter beds (5 primary and 4 secondary tanks), all connected by the usual open channels.

Construction.—Generally, the foundations consist of 1 to 5 Portland cement concrete; the ordinary brickwork of hard red stock bricks laid in cement mortar, and the exposed top courses of blue Staffordshire diagonal paving bricks. All interior walls are rendered with 1 to 2 cement mortar.

Silt Pit.—The dimensions of this are 8 ft. by 5 ft. by 3 ft. 6 inches deep, with a wall across the centre to retard the flow of the sewage. There is a platform, of concrete floated with cement mortar, on which the silt is collected for removal, the liquid being allowed to drain back into the pit.

Settling Tanks.—These are 10 ft. by 22 ft., the depth at the upper end being 6 ft. 9 inches and at the lower, where there is a sump pit, 7 ft. 9 inches, the depth of the sump itself being 2 ft. below floor level. The floor is laid with a slope to the sump of 1 in 10 from the side and 1 in 22 from the end.

Between the silt pit and the settling tanks is a Ham Baker screen. The flow of sewage from the silt pit can be directed into either tank by means of a Ham Baker hand sewage valve. The tanks are emptied either by a Ham Baker flushing valve or a Stone's rotary pump. The exit to the tanks is over one wall, which is made 3 inches lower for its whole length than the other walls. Any scum which may rise and any floating material is caught by a scum board, cross section 9 inches by 1 inch, which is bolted to the exit wall and bedded into the others.

Filter Beds.—The 5 *primary tanks* are 30 ft. by 22 ft. 6 inches, the depth varying from 5 ft. at the top end to 5 ft. 3 inches at the lower, thus giving the floor a slope of 1 in 120. Each bed can be cut off by a hand sewage valve.

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The beds are filled to within 7 inches of the top with clinker in three layers, large stuff at the bottom, 2-inch cube pieces in the middle, and fine stuff at the surface. The clinker is prevented from being washed out by a chamber of 9-inch brickwork at the middle of the lower end, its dimensions being 2 ft. 3 inches by 1 ft. 10½ inches; small holes are left in the bottom courses to permit of the liquid entering. In the outside wall is a small square hole which is opened or closed by a Ham Baker 6-inch penstock, fitted inside the chamber and bolted to the wall. To prevent the liquid discharging over the channel, the wall of the channel, for a length of 2 ft. 3 inches opposite the exit hole, is raised 2 ft. above the level of the channel.

The 4 *secondary tanks* are similar to the primary. Their dimensions are 60 ft. by 22 ft. 6 inches, the depth being 2 ft. 6 inches at the upper end and 3 ft. at the lower, the slope of the floor thus being the same as in the primary tanks.

The clinker is laid to within 7 inches of the top, as before, but in two layers, 3-inch cube stuff at bottom with a 1-ft. 8-inch layer of fine stuff above. The inlets are regulated by hand valves. There are outlet chambers as in the primary tanks, but smaller; and the penstocks are fixed to the outside of the wall.

Channels.—The main channels connecting the various beds are 12 inches broad, the branch ones 9 inches.

Working.—The works deal with the foul drainage system only, surface water being disposed of separately. The sewage is delivered through a 12-inch main sewer to the silt pit, where all the heavier solids are allowed to sink, and are constantly raked out and carted away to be buried. It then passes through the screen (where all the light material, such as bits of paper, etc., are caught and constantly removed for disposal by burying) to a settling tank, where it is made to flow very slowly so as to allow as much sludge as possible to be precipitated. The sludge is emptied out as soon as the tank is nearly full, and is disposed of like the other stuff previously removed. The heavy scum, which rises to the surface while the sewage is passing through, is prevented from flowing on by means of the scum board.

Having been purified as much as possible of solid matter, the liquid now passes to one of the primary tanks. When the tank is full, the sewage is allowed to stand for 1 to 3 hours, according to its state and strength, the time being determined by the man in charge. A skilled foreman can tell by the appearance and smell of the liquid when the right amount of action has taken place. In these primary tanks, though not in the secondary ones, the sewage can be kept too long, whereby it becomes soured and the whole biological action is adversely affected.

The necessary interval having elapsed, the effluent is then allowed to pass through the penstocks into the secondary tanks, where it is retained as long as possible in order to complete the biological action,

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due regard being paid of course to the necessity of always having sufficient tank space available to take the next instalment of sewage.

The effluent from these secondary tanks should be up to Thames Conservancy standard* for water from sewage farms flowing into the Thames or its tributaries. However, it is still further treated to make certain of its freedom from pollution. It is first run over a large area of ground sown with rye grass; to produce aeration it is then made to fall over steps constructed of sheets of corrugated iron; and finally it is distributed over another large area of rye grass, eventually flowing through open channels into the river Blackwater.

Labour.—It has been found necessary to employ 1 foreman and 2 unskilled labourers all the year round to work the installation and keep it in proper order.

There is a similar installation on the same farm for the barracks at Blackdown, which contain two battalions of Infantry and the headquarters of an Infantry Brigade. In this the tanks are half as large again as those just described.

* The Thames Conservancy Act, 1894, para. 93, lays down that no person is allowed to admit "sewage or any other offensive or injurious matter, whether solid or fluid" into the Thames or any tributary. Sewage is usually taken to mean any water which contains more than 2·5 parts per million of albuminoid ammonia.

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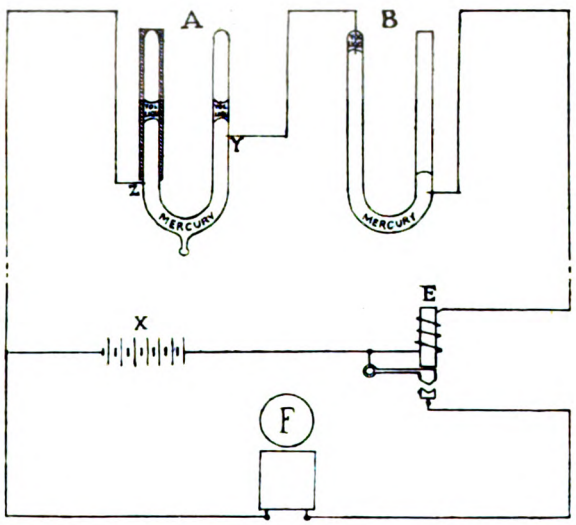
AN AUTOMATIC FIRE ALARM.

By MAJOR H. HULEATT, R.E.

A VERY ingenious apparatus, called the Autopyrophone, has recently been introduced into this country by the Autopyrophone Co. of Copenhagen. The detector is a double one, one part "A" to detect a sudden outbreak of fire in which the temperature rises rapidly, and the other "B" to give an alarm when the temperature reaches a certain given height, as in the case of a smouldering fire.



The part "A" consists of a U-shaped sealed glass tube about half full of mercury, above which there is a small quantity of volatile liquid in both branches. An electric current passes through the mercury, connection being made by platinum wires passing into both branches of the tube. One branch of the tube is jacketed with a material of low heat conductivity. If the temperature of the room rises suddenly the volatile liquid in the bare branch expands more rapidly than that in the jacketed one; the mercury in the former branch is then depressed below the platinum wire, and the circuit is broken, giving an alarm.

If the rise of temperature is very slow the tube "A" will not act and "B" comes into play. The latter device consists of a U-shaped glass tube half full of mercury, open at one end and closed at the

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other. At the top of the closed end there is, above the mercury, a small quantity of liquid of which the boiling point coincides with the temperature at which a call is wished for. When this temperature is reached the liquid will start boiling, the mercury will be driven down by the vapour below the platinum wire, and the circuit will be broken and an alarm given as before.

A test of the apparatus has recently been made by the British Fire Prevention Committee and their report will shortly be published.

In the diagram A and B are the two parts of the detector, X is the battery, E the Indicator Relay ; one armature of the relay falls when the primary circuit is broken, causing an alarm to be given on the fire call F.

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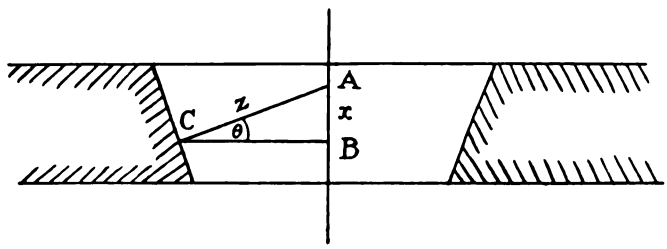
CONE CLUTCH DESIGN.

By Capt. J. D. Monro, R.E.

In all petrol motor cars a clutch of some form is provided for rapidly disconnecting the motor from the transmission system. It is usually an ordinary cone clutch, kept in engagement by a spring; but clutches of the expanding ring form are also in use.

The angle of the cone depends upon the coefficient of friction of the materials employed. Cast iron and leather are most generally used; and with these the coefficient of friction may be taken as ·25, and the angle of the cone as 15°.



In the diagram AB is the axis of the clutch shaft. From any point A on the line AB draw AC normal to the face of the clutch, and from C draw CB at right angles to AB. Then ACB=θ is the angle of the cone.

If AB to scale equals x, the axial force pressing the convex part of the clutch into the concave part, then AC to the same scale represents z, the resulting pressure perpendicular to the surface of the cone,

and
$$\frac{AC}{AB}=\frac{z}{x}=\frac{1}{\sin\theta}.$$

Therefore
$$z=\frac{x}{\sin\theta}.$$

Now the mean twisting moment M in ft. lbs. in the shaft is

$$M=\frac{33000\,H}{2\pi N},$$

where H is the H.P. transmitted and N the number of revolutions per minute; and if r is the mean radius of the clutch in inches, the twisting force in lbs. to be transmitted by the clutch is

$$\frac{33000\,H}{2\pi N}\times\frac{12}{r}=\frac{63000\,H}{Nr}.$$

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So that when the clutch does not slip

$$\frac{63000\ H}{Nr} = zf$$

where f is the coefficient of friction,

i.e., $$H = \frac{Nrzf}{63000} = \frac{Nrfx}{63000 \sin \theta}.$$

Taking $f = \cdot 25$ and $\theta = 15°$, $\sin \theta = \cdot 2588$,

then $$H = \frac{Nrx}{65200} \text{ approximately,}$$

and $$x = \frac{65200\ H}{Nr},\ r = \frac{65200\ H}{Nx}.$$

For example, if it is required to find the diameter of clutch suitable to transmit 12 H.P. at 1,000 revolutions per minute with a spring pressure of 100 lbs.,

$$r = \frac{65200 \times 12}{1000 \times 100} = 7 \cdot 824,$$

whence the diameter is 16 inches nearly.

Or, again, to find the strength of spring required for a clutch 5 inches diameter to transmit 3 H.P. at 2,000 revolutions per minute,

$$x = \frac{65200 \times 3}{2000 \times 5} = 195 \cdot 6, \text{ say } 200 \text{ lbs.}$$

The width of the surfaces of the cone depends on the amount of pressure allowed per square inch : this should not exceed 50 lbs.

If W = width of cone surface, the area is $2\pi r$W ;

then $$W = \frac{z}{2\pi r 50} = \frac{x}{100\pi r \sin \theta} = \frac{\cdot 0123\ x}{r}.$$

In the example above, $x = 200$ lbs., $r = 2 \cdot 5$ inches, so

$$W = \frac{\cdot 0123 \times 200}{2 \cdot 5} = \cdot 984, \text{ say } 1 \text{ inch.}$$

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WITH THE ALLIES IN CHINA, 1900–01.

By CAPT. J. E. E. CRASTER, R.E.

I HAVE been asked to give an account of some of my experiences in China during the operations of 1900 and 1901. It is a difficult and in some ways a delicate undertaking. I kept no diary of my own doings, and the accounts that I received of the experiences of others were generally incomplete and often embellished. It was not easy at the time, and it is now (after three years have elapsed) impossible, to sift the wheat from the chaff.

The best sources of information were not open to me. I cannot, therefore, pretend to write with accuracy of episodes that occurred outside the small circle of my own personal experience. Nor have I the necessary materials at my disposal to enable me to piece together an account of the chief events, which would be complete or reliable enough to pass muster as a history of the Boxer rising.

All that it is possible for me to do is to dwell upon a few minor and (from a historical point of view) unimportant details, the description of which may in some slight measure add interest to the principal incidents, which I must leave to others to chronicle.

It may perhaps be desirable to explain how the Boxer forces were recruited.

The movement was originally directed against the reigning dynasty, the object of the agitation being to terminate the Manchu dominion of China and to place a Chinese Emperor on the throne. It was hoped that the way would thus be cleared for reforms, and that the people would be relieved from the oppression of the mandarins.

The Dowager Empress, however, soon contrived to turn the attention of the Boxers from herself and her court, and to focus it on the universally detested foreigner. That she desired to involve China in a war with Europe is very doubtful.* She probably acquiesced in an attack on the foreign settlements and legations, as it appeared to be the only alternative to her own deposition. She could not dam the flood that threatened her throne, so in self-defence she diverted it.

The prospect of butchering the Europeans and looting their settlements attracted ruffians of every description to the Boxer standards.

* When the European fleets attacked and captured the Taku Forts, she was seized with the strange delusion that Europe was making war on China.

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A large number of recruits were found among the crews of the junks trading on the Peho, whose profits had been adversely affected by the opening of the railway to Pekin.*

The Boxer forces as finally constituted comprised;—firstly, a few genuine patriots, who believed that they were fighting for the deliverance of China from the evil spells which the Europeans had cast over their country; secondly, a large number of scoundrels attracted by the prospect of loot; and thirdly, a considerable proportion of honest men, who found it safer to join the Boxers than to remain neutral.

It was the custom of the Boxers to quarter themselves on a group of villages until they had consumed the whole of the food supplies in that district; they would then move on, taking with them the villagers, whose only alternative was to remain behind and starve. Sometimes the latter had no choice in the matter, for the Boxers frequently murdered those who would not join their ranks

The Boxers had a rudimentary form of discipline and were taught a curious drill. Some, with whom we came in contact near Tientsin, were apparently manœuvred with the help of flags and banners, of which they carried a considerable number. If the banners pointed to the front, the line advanced; when they were planted in the ground, the Boxers halted; when they were lowered, the line lay down. It is quite possible that on this point I have mistaken cause for effect, and that the flags were merely used as rallying points.

The Boxers had with them a few mules and ponies, which were used for carrying away the wounded, though probably it was not their original intention to employ them in this way.†

They were armed with Mannlicher, Mauser, Winchester, Remington, Snider and other rifles; they also had smooth-bore muskets and carbines, some bearing the Tower mark. Lastly they had jingals, though these were by no means the least among their firearms. A jingal, sometimes known as a three-man gun, is a fowling piece with a bore of an inch (or thereabouts) and a length of eight or ten feet. It is used, I believe, in peace time as a duck gun, and is mounted in the bow of a sampan or small boat. There are, however, in addition rifled breech-loading jingals, fitted with a Mauser bolt action and using a solid drawn brass cartridge. The jingals that I saw in action were mounted on rickshaws, and from a distance looked very like field guns.

The Boxers' fire was as a rule most effective at the extreme range of their rifles. Presumably they put their sights up to make their

* The burning of a railway station near Pekin was one of the first acts of open hostility on the part of the Boxers. It was the work of these men.

† The Boxers believed themselves to be bullet proof.

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rifles hit harder. When within moderate range of the Boxers you might feel tolerably safe in the knowledge that the vast majority of their bullets would go over your head. A muzzle-loading jingal, however, was always a source of anxiety; for, if the powder ran short, its enormous bullet might descend upon you, even though you were comparatively close to the weapon.

Those of the Boxers who had no firearms, carried spears, halberts, swords and banners. The last were triangular, and bore inscriptions or devices. Three good specimens were taken by the Bombay Sappers and Miners near Tientsin. The first was a police station flag from the village of Kau-ja-chung, and had evidently been misappropriated by the Boxers; the second had the word "Assistance" emblazoned on it in Chinese character; the third had a well-known Chinese device, which is supposed to ward off the evil eye and was, I believe, in this case intended to render the bearer bullet proof; the flag is stained with the blood of the man who carried it.

The Boxers whom I saw wore no special dress or distinguishing mark, but there was one old man among them who appeared to be wearing a large red wig. He did not wait for us to investigate further.

It is not easy to say how far the movements of the Boxers, or indeed of the Chinese regular troops, were controlled from Pekin. The Boxers were at best an unruly crowd, and the Imperial soldiers were not much better. The following version of the Chinese plan of campaign was at one time current in Tientsin, and obtained a certain amount of credence, although I do not believe it found acceptance in official circles.

The Chinese, so the report went, decided to make their great effort at Tientsin. Every soldier who was within reach, and every gun that could be hauled across country, were to be employed in driving the Europeans out of the Tientsin Concessions.*

Victory at Tientsin was to be the signal for a rising against the

* The Concessions form the European town of Tientsin, and are situated some one and a-half miles from the native city. The fighting at Tientsin was severe. The French Concession, which bore the brunt of the Chinese bombardment, was wrecked, and considerable damage was done to the British Concession also. The railway station—an isolated post on the far bank of the river—was so riddled with shot and shell that it was difficult to understand how the garrison had contrived to hold it and survive. The severity of this fighting and the magnitude of the stakes at issue were, I think, never appreciated in England. The newspaper correspondents came out later. Even in official circles, if I may be permitted to say so, the gallant defence of Tientsin has received little recognition. The relief of the Pekin legations was dramatic; the defence of Tientsin was, as far as I could learn from those who had been present at both, a far more difficult and costly feat of arms. I hasten to add that I personally was not present at the defence of Tientsin.

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foreigners throughout China ; even the Pekin legations were to be preserved until after the fall of Tientsin.

The Shantung Viceroy had with him at the time a large body of troops—some said 100,000. These had been trained by Europeans, and were armed with Mannlicher rifles and modern field guns ; they were, in short, the most formidable army in China.

The Viceroy, so the story went, received orders from Pekin to march on Tientsin and assist the Chinese generals who were already engaged in an attack on the Concessions. He started, as in duty bound ; and had gone some considerable distance when he received news that the foreigners, instead of being driven out of the Concessions, had captured the Tientsin native city. After that he halted for several days to consider the matter, and finally returned to Shantung, suppressing the Boxers on his way.

I give this story for what it is worth. I have no certain knowledge that it contains one grain of truth. It is interesting chiefly in view of what might have happened if the Shantung Viceroy had actually attacked with his large army. He would probably have arrived at Tientsin soon after the relief column had set out for Pekin, and when, consequently, the former town was held by a very small garrison. There is little doubt that he might then have captured Tientsin, or at least have effectually isolated it, both from Pekin and Taku.

The resulting situation would have been a curious one :—Pekin, the capital of China, in the hands of the Allies, and Tientsin, the Allies' advanced base, in the hands of the Chinese. There would, in fact, have been every prospect of as pretty a campaign as any general could wish to avoid.

These are, however, idle speculations. I have given a short description of our enemies, the Boxers, so now let us turn to our allies.

The first point that impressed me, was the extreme readiness of the European soldier to let off his rifle ; he seemed to prefer to shoot at nothing rather than not to shoot at all. The sentries furnished by the freshly landed European troops nearly always contrived to fire several rounds each night, even though they were posted well inside the Tientsin defences, sometimes even in the heart of the town.

We were subjected to a most unpleasant form of this night-firing nuisance on New Year's Eve, when each of the sentries of one of the contingents saluted the New Year with three shots. They should of course have been blank rounds, but apparently the majority were ball. The number of bullets that came over the West Village, in which some of our troops were quartered, was so great that our troops stood to arms. If the firing directed towards the other points of the compass was as heavy,—and why should we suppose that the said sentries pointed their rifles in our direction more than in any other,—there must next morning have been a considerable deficiency of ball ammunition among the troops of that contingent.

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One night, when I was encamped with a small detachment on the banks of the Peho, our camp was fired into by a European soldier on a passing junk. The junk was near enough for us to hear the man talking, but it was so dark that he could not have seen the camp and must merely have fired at a light outside my tent. I could give several other instances of the reckless way in which our allies wasted their ammunition.

In India ammunition has a marked tendency to gravitate towards the frontier; consequently a strict account must be kept of every round, and a sepoy who mislays one or two is likely to be tried by Court-Martial. The direct result of this vigilance was shown in the reluctance of the sepoy sentry to fire, even under the greatest provocation. This forbearance was, I fear, attributed by some of our allies to cowardice; but cowardice or forbearance, some of them owed their lives to the quality.

I think we awaited the arrival of the German troops with more interest than we devoted to our other allies. The German army had always been held up to us as the ideal at which we should aim, and consequently we hoped to learn a good deal from closer acquaintance with it.

Their contingent had no efficient means of locomotion, having landed in China with practically no transport. They had some large waggons, the wheel track of which was too broad for any Chinese country road. Also they had bought, at a high price, a large number of Australian horses, the majority of which did not survive long, as they had just got rid of their winter coats in preparation for the Australian summer and rapidly succumbed to neglect and the rigours of a Chinese winter.

The soldiers themselves were well set-up, sturdy men; picked troops, by the look of them. They suffered a good deal from enteric. This was no doubt partly due to the fact that the men were young and unseasoned; but was also attributable, I think, to lack of sanitation and to eating Chinese food. The other European troops in China seemed to be practically free from the disease. The German barracks were crowded to an extent that would not be allowed by our medical authorities. In some rooms the men slept in bunks arranged in three tiers.

The discipline of the German troops was strict, and their close order drill excellent.

They arrived in China dressed in khaki, and wearing soft straw hats looped up at one side. Unfortunately the khaki would not wash, and the straw hats soon shed their brims. I heard that about this time one or two English manufacturers of cork helmets made their fortunes. The helmet adopted by the German troops was a strange khaki contrivance with a hinged flap at the back, which could be turned up out of the way when the soldier lay down to fire. Some-

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times the flap turned up quite quietly and of its own accord. The object of covering the helmet with khaki was soon forgotten, and before long it was ornamented with a brass eagle in front, and coloured ribbons round the *puggaree* to denote the wearer's regiment.

The organization of their scientific corps was the very opposite of ours. The German pioneers correspond to our field companies; their work, however, is limited to field trenches, demolitions and pontooning. Their railway battalions and telegraph battalions constitute altogether separate and distinct services. Their engineering branches are, in fact, kept in hermetrically sealed compartments. There is a lack of any central authority, corresponding to our C.R.E., who can ensure co-operation between the various corps.

The result was as follows. When the Germans were repairing the railway and constructing their telegraph lines, the work made comparatively slow progress, and both the railway and telegraph troops were overworked; but at the same time their pioneers were doing barrack-square drill and gymnastics, to keep the men fit.

We had three field companies and a balloon section, which were employed with their officers at various times on railways, telegraphs, hutting and fortifications. We had in addition a weak telegraph section and a skeleton railway section, but neither would have been able to get their work done unless they had been reinforced from the field companies.

The separate compartment system, as exemplified by the German organization, is one that cannot be recommended. The Indian R.E. organization stood the test of the campaign extremely well; no doubt it is not perfect, but it is far preferable to the German system.

It may be of interest to note that the German officers in China received fifteen marks a day over and above their ordinary pay, and also a certain amount in the way of free rations, etc.

The French, who were in North China in the earlier operations, were chiefly Colonial troops, including members of the Corps Disciplinaire. They looked unfit and fever stricken. They were dressed in blue cotton uniforms with white helmets, over which they wore a blue cover.

The regiments which came direct from France were of two distinct types. There was one, raised from the Paris garrison for service in China, composed of very small men of poor physique. The Zouaves, on the other hand, though small were very muscular and thick set; they appeared to be older men than their comrades from Paris, and were in my opinion some of the best European troops in China. The Chasseurs d'Afrique, mounted on barbs, were very good specimens of light cavalry.

The French staff work appeared to be very good. Their troops moved about from place to place without any fuss, and usually without their departure being anticipated by their allies. Along all the roads

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the French maintained sign posts, which not only gave the distance of the next station, but also information as to short cuts that could be taken in dry weather, and their suitability for wheeled traffic.

We saw very little of the French engineers, but a good deal of their handiwork. If ever you meet a French engineer, take off your hat to him, for he is an artist. Their work, especially as exemplified in their bridges, was excellent. Their floating bridges were always in good repair, whereas bridges made by the other nations were soon allowed to degenerate into forlorn clusters of half-sunken junks.

Many of the French engineers were artillery officers. The explanation of this anomaly is that artillery officers are all put through the same course as those of engineers; in the absence of an engineer officer, they are held responsible for the execution of engineer works, and therefore take command of any sappers who may be present at the station or post. One artillery officer informed me that he had been employed for several years in building barracks in Cochin China.

I believe I am right in saying that the French Artillery, as such, favourably impressed our own artillery officers.

The French troops were very quick to adapt themselves to the conditions of the country. They used the Chinese rice cauldrons for cooking their food, and often had their dinners ready before our troops had made out their ration indents. I asked a French officer at what hour his men usually had their dinners. He replied: "When I am satisfied that they have finished their work." *Verb. Sap.*

The French transport was well organized. They had a fleet of junks for the river, a cart corps and a camel corps for the roads. Their carts were of two types, both two-wheeled; the wheels being in each case made of some light composition—*papier maché* I think—very large and broad in the rim. The body of the first type of cart consisted simply of a wooden grating resting on the axle. The second type had a bent steel axle; the bottom was galvanized iron, and the sides iron lattice work. These carts each had a Chinese driver, and were drawn by one or two mules. The French camel corps was composed of camels from Central Asia, which arrive at Pekin in large numbers in the winter; the drivers, who I suppose were also the owners, were Chinese or Mongols.

This article has already extended beyond the limits that I originally intended for it, so I find that I have no space for a description of our other allies or of our friends the Americans. As regards our own troops and their organization, I do not wish it to be supposed that absence of criticism implies the absence of defects.

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STATUES.

By CONCORDIA.

IN the absorbing study of human life, and what must and what may happen to man, one thing in the very nature of things appears to be a certainty, judging by what has gone before, and that is that statues will still continue to be made.

We do not know who it was that first made a statue of a man, but think it was the Egyptians who originally entered into the business, and they commenced the art at a very remote period.

Palæolithic men, so far as can be traced, made no statues or graven images of a durable nature, the tools of the period Circa 60,000 B.C.—10,000 B.C. being quite incapable of use for the purpose required.

But then came the new age, when the so-called neolithic men, of geologically speaking modern times, as a substitute for statues to the individual hunter, reared aloft their mighty temple of Stonehenge; a central monumental structure in memory of the great departed, and to the worship of an infinite power; Stonehenge with its huge horseshoes of majestic trilithons, a polished gem amidst a setting of rough, uncut and fractured stones, standing out against the eastern horizon at the rising of the midsummer sun. So it stands, simplest and most dignified of memorials, as an earnest reminder to us that our prehistoric ancestors could build, not for a passing moment only but for an age in point of time.

Neolithic man did not, however, seek to perpetuate in stone, only for a brief span, the mere corporeal carcase of the individual man, but raised up a magnificent national memorial, symbolical of the combined virtues of the great ones gone before, and to the glory and immutability of the power they worshipped, an infinitely long space of time and an infinitely great amount of patient labour on the part of the living being expended in the course of the work.

As for personal statues made for showing off in a public place, we know that they were made more than 2,000 years ago, and are still being made; those people who could not get good statues had to be content, as we now are, with bad ones.

As civilization began to dawn, with its accompanying egotistical ideas, many statues of their gods and kings were made by the Egyptians. Some of these statues possibly bore some resemblance to the originals; many of them were colossal, constructed of very smooth stones; but the attitudes were awkward and stiff, and

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certainly did not always represent the beauty of the human form divine.

The Greeks, following on, began by making statues of their deities, who fortunately for art were represented by men and women. Then by degrees they commenced on national heroes, statesmen, soldiers and poets.

Cicero mentions a statue being put up to the memory of a great poet some centuries after his decease. This statue was made to replace another in honour of somebody else whom nobody living had heard of or ever cared to hear much about. He describes the statue as the figure of an old man, bent with age, with a book in one hand. In the statue, the bald, stooping, old poet is represented as leaning on a strong staff, reading a roll, and well employed. He was probably engaged in reading a good book, perhaps his own poems, and so we feel no concern for him, knowing that he will never be tired.

How different to some of the present-day statues, where we see a man standing for ever on his legs in a public place, doing nothing but stand, and seeming as if he were never going to do anything else. One would rather see a living man standing on an inverted beer barrel than the mere effigy of a man standing on a stone pedestal, for the living man expresses something, the stone man expresses nothing.

When the Greeks did begin to set up statues they went on at a great rate. Philippus of Croton, who fell in battle in Sicily, said to be the comeliest of all the Greeks of his age, was immortalized by the people of Segeste, who built up an heroum or monument over his burial place where sacrifices were offered up to him.

The Romans followed the Greeks, and we follow the Romans.

Such was the rage for statues amongst the Romans that prominent men and others had their own effigies erected in public during their lifetime. Such also was their bad taste at times, that they even dressed themselves for the occasion in Greek costume. Scipio, who conquered Antiochus the Great, was placed in the Roman capitol got up in a Greek dress and in Greek footgear.

Curiously, or consequentially as the case may be, some of our truly British statues follow suit, the statesman or poet being enwrapped in a blanketlike robe, which those of artistic temperament might call a Roman toga. Either let us set up our heroes stark naked, or dress them in a suitable costume as decent British gentlemen. The Romans put up a naked statue to the great Admiral Agrippa, but the statue was colossal and Agrippa was a deified hero. Britannia's naval god of war is perched up on the top of a lofty celestial pillar, as far away out of the public ken as possible.

What is the reason that so many people in London pass our statues continually, and do not pause to look at them ? Is it because familiarity breeds contempt, or because some of our statues are so

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black and ugly ? To most of these people it matters not a jot what an outdoor statue is like ; they can do very well without it, and if it must be had, they are easily satisfied.

The Romans were sometimes wont to gild their bronze statues. Nero ordered an Alexander by Lysippus to be so treated, but it was found that the beauty of the work was spoiled in the process, and the gilt was removed. Lysippus, who knew his art well, used to say "other sculptors make men just as they are, but I make them as they seem to me." In his bronze statue of Alexander he depicted him carrying a spear in his hand, and with his face looking up, which indeed was the king's fashion, as he always carried his neck a little on one side. The inscription on this statue is an appropriate one—

"Looking to Zeus, the bronze appears to say,
I made the earth, keep thou Olympus."

A seated black statue in the open air is not to be commended. Our London statues of Cartwright looking like an old cobbler on his stool, and that of Fox, worse treated still, blanket dressed, fat and black, are patent examples. Is it to be wondered at that on a recent occasion one of our transatlantic cousins mistook the latter for a negress, the emblem of British philanthropy, and a memorial of the abolition of slavery ?

The Greeks were the first people to mount their statues on various types of animals. Europa was seated on a bull, Aphrodite on a bronze he-goat. One of the most beautiful specimens of their antient art was a woman seated on a species of tiger, with one hand on his neck, the other grasping a thyrsus. She sits upright, bare to the waist ; her drapery is well secured round her middle and, hanging down, leaves her feet free. The beast is galloping at a great rate, but the woman is so firmly seated that there is no fear of her coming off.

The usual beasts on which we mount our heroes have been horses. Nor is there considered to be much beauty in a horse standing still, with a man's legs dangling tamely from the beast's back ; neither is the matter mended by both horse and rider being of colossal size. It is however a consolation that these statues must by the nature of the case be rare ; and it is most fortunate that we see little of them except at a distance, which is really the best position from which to view them.

Zenodorus, a great Greek sculptor, was noted for the size of his work, one of his commissions from the reigning Emperor Nero being for a statue of his imperial majesty 110 feet in height—and he made it. Zenodorus beat all his predecessors in this respect.

Women from time immemorial appear to have been very scantily treated in regard to statues, the idea being that all women were fully entitled to a statue at home, if only they were willing to pay for it. The Romans were more generous than were the Greeks,

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sometimes placing their statues of women in the open, and occasionally on horseback. The Roman girl, a hostage in the Tuscan camp, who escaped by swimming across the Tiber, was immortalized by an equestrian statue erected on the top of the Viâ Sacra. Cornelia, the daughter of the conqueror of Hannibal, and the mother of two reforming sons, who, by the way, suffered the usual fate of reformers, had a bronze statue set up to her with inscription "To Cornelia, the mother of the Gracchi."

Has not England ever produced a woman, other than a queen, worthy to be honoured in bronze or even in stone at the public cost? The French have their Jeanne d'Arc, burnt alive by the English, and Jeanne will never be forgotten! We might perhaps find such a one without much difficulty, not a fighting woman perhaps, but one who was the equal of Jeanne in courage and had possibly a good deal more common sense.

Those ladies amongst the Greeks who did attain the distinction of a statue were more often noted for other things than careful housekeeping. Praxiteles made a statue of the beautiful Phryne in marble, with a replica in gilt which was readily and speedily disposed of by Phryne, who despatched the same to Delphi, the Salvation Army headquarters of the times. Silanion, the Athenian, made a statue of the Lesbian Sappho, the Syracusan, some centuries after her death, but Verres, the Governor of Sicily, well known as the greatest thief on record, fell in love with it and carried it off. The statue has now perished, but the fame of Sappho lives in her own immortal verse.

As we have always been a fighting people, so have we been great makers of statues of fighting men. But as a rule these statues have been so tame and lifeless that we only know them to be fighting men by their dress. Why do we not also make statues of our athletes,—boxers and wrestlers, riders, cricket players, footballers, marksmen and motor-car racing champions.

Lysippus made statues of both kings and boxers. He it was who made the famous statue at Olympia of Polydamas, the biggest and strongest man that had appeared since the days of Hercules. Polydamas was the one man who had, unarmed, killed a lion, whose tracks he crossed when wandering in the forests of Olympus; but unlike Hercules, who in his historic encounter with a wiry ancestor of this noble beast was armed with a club, Polydamas had no weapon.

It appears to be singular, or otherwise as the case may be, that we, who as a nation pride ourselves on our prowess in all bodily exercises more so than any other modern nation save perhaps the Japanese, have not used our sculptors to immortalize our athletic heroes. There is authority for the treatment of such subjects, such as representing a boxer in a fighting attitude, even if he be not actually bruising another. A place such as a Pantheon would be required for

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depositing these statues in, for it would be clearly inadmissible for them to be welcomed inside our churches, which are exclusively reserved for those fighting men who have fought in their country's cause.

The time may yet come when we shall find some way of making statues of cheaper material than metal. Perhaps we shall make them of paper! That will indeed be a truly glorious time! Then we may all have our own statues, living or dead; and what is better, we shall not then be plagued with those periodical demands for subscriptions to statues of men whom we never saw and do not much remember about.

If there are men now living, looking forward to the honour (if it is an honour) of being set up in bronze in the public highways or in marble in some covered-in building, if it be permissible to advise, we would humbly say "Leave a legacy in your will for your own statue." It will save much trouble, and people will think all the better of you when you are gone if you cost them nothing. As to their laughing at you for looking after your own effigy, be not afraid. There is good classical authority for providing by will for your own monument; and if a man does really expect or fear that he must after death stand before the British public to be gazed at and rained on, he will best leave matters to his executor, paying the artist well, and thus escape the taste of a committee.

The Romans when they set up a public statue acted as follows:— Servius Sulpicius, a great man, died on duty. His friend Scipio pronounced a panegyric in the senate, and moved that a bronze statue of Servius be placed on the Rostra, no special sum of money being mentioned. The consuls were then empowered to instruct the treasury to make the contract and pay the artist. When the right artist had been found, they allowed him to have his own way, and did not higgle about the statue, pedestal or funds.

With regard to statues, as in all things, so in this there are degrees. Some men have been imbronzed during their lifetime, and have actually seen themselves bestriding horses, brazen men on brazen beasts. But this is rare. Other men wait until they are dead, and enjoy the statue by anticipation, being comforted by the prospect of their immortality in bronze, marble, or even freestone.

Some men may be content with a marble bust, which they may get in their lifetime, either by hiring a man to make it or by the kind attention of friends. Indeed we have only to go to a well-known glass house near the Metropolis, to see in rows, placed side by side, plaster busts of the illustrious dead aligned with those of some of the not illustrious living. But it is hard to understand how these busts found their way there, unless sent in by the living originals, the general conclusion being that many of them were not placed there for their beauty, and that others were inserted so that vacant

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pedestals might be filled up; these latter may in time have to make way for other heads that may perhaps have something in them. In the meanwhile we will take it for granted that any face is welcome there, so long as there is room for more.

A striking example of statuesque, up to date, architecture may now be seen in the vicinity of High Holborn, where a newly-constructed large financial house is surcingled by a string course of plaques, adorned by the trunkless heads of great statesmen, engineers, musicians and artists, financial magnates and military engineers being conspicuous by their absence.

Now recapitulating, as far as can be gathered the Egyptians first commenced the art of personal public statue construction, of their gods and kings; the Greeks followed suit with statues to genuine heroes, such heroes as in modern times would almost be made saints; the Romans amplified the numbers of those deserving statues, and we have followed the Romans; but the end is not yet.

> "When you and I behind the veil are past,
> Oh, but the long, long while the world shall last,
> Which of our coming and departure heeds
> As the sea's self should heed a pebble-cast.
>
> "Why, if the soul can fling the Dust aside,
> And naked on the Air of Heaven ride,
> Were't not a Shame,—were't not a Shame for him
> In this clay carcase crippled to abide."

Therefore why build public statues at huge cost for our own departed men of renown and daring, and place them in positions where they may be criticized by a scoffing public not in touch with the spirit of a bygone age. Rather let us build a private valhalla or museum, call it what you will, on our own precincts and fill it with memorials expressive of the soul, mind and character of those we seek to honour. A fine portrait, or a miniature procurable at a fraction of the cost of a so-called indestructible statue, will convey more than an image in metal or in stone to the comparatively few generations who have come under the spell of the great ones lost to view. This valhalla will take the place now filled by the family portrait galleries, the pride and interest of so many of the antient homes of England; or will form a haven of rest, sacred to the members of whatever great corps it represents, open to the private view only of the living and their friends, and not approachable to the self-satisfied and unsympathetic section of the vulgar unpatriotic public.

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TRANSLATIONS.

MOTOR BATTERIES FOR FORTRESS WARFARE.*

(*From the* MILITÄR WOCHENBLÄTT, *3rd November*, 1904).

That motor cars will have a very important part to play in the war of the future is scarcely open to doubt in view of the extensive employment that has been made of them in the more important autumn manœuvres of all armies, both for the conveyance of the superior officers of the Staff and for the transmission of orders to a distance. Attempts to transport heavy loads by motor wagons are less well known, though there can be no doubt that, with the increased size of modern armies, this method of forwarding supplies, etc., forms an equally important field for their employment. Realizing this, the Prussian Ministries of War and of Agriculture offered a prize in 1902 for the construction of a motor wagon, driven by spirit, which was to draw a load of 15 tons† along a good road at an average speed of 3 miles per hour and 43 miles per diem and at the same time be able to negotiate gradients of 1 in 10.

The supply of such wagons would be of special importance for fortress warfare. Whether experiments on a large scale for the transport of guns and ammunition have been made in any other country, and with what success, is not known. It is all the more interesting to hear that such experiments have recently been made in Portugal, apparently with great success. The order for this was due to a suggestion by Colonel of Engineers du Bocage, upon which the Portuguese Government ordered a battery of four 6-inch howitzers from the gun factory of Schneider & Co. at Creuzot. This battery with its ammunition is drawn by *one* traction engine, and is intended for the defence of Lisbon.

The traction engine (or motor wagon)—built on the Brillié system—weighs 7 tons, and is capable of carrying a useful load of 5 tons (ammunition, equipment and men) besides drawing four 6-inch howitzers, weighing in all 14 tons, on roads having a maximum gradient of 1 in 12.5. With steeper gradients, up to 1 in 8, the traction engine ascends alone, unwinding a strong wire rope from a drum; its wheels are then scotched up, and the howitzers are wound in.‡ It is possible to regulate the speed according to the condition of the roads and the amount of the load

* Communicated by the Chief of the General Staff.

† The various dimensions and weights in this article have been reduced to the nearest English equivalents.

‡ In an experiment, where three howitzers were attached, gradients of 1 in 5 were surmounted, of course with the aid of the rope drum.

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i.e., to 1·5, 3·28, 5·8, 8·8 English miles per hour. The supply of water and fuel (benzine, alcohol or petrol) is calculated for a distance of 50 miles; but there is no difficulty in carrying a larger supply in cans. The total load drawn is thus 26 tons, for which at least 50* horses would be required. But inasmuch as a day's journey for horses is about 15 to 18 miles, while the traction engine can easily do 40 to 50 miles, it follows that the latter is equivalent to at least 100 horses. In addition a considerable saving in attendance is effected.

The wagon itself carries 64 shells. The design includes a separate ammunition train consisting of four ammunition wagons, each of which carries 40 shells, and their motor wagon also carries 64 shells. Thus these two trains carry 288 rounds, 72 for each howitzer, and they occupy on a road a length of not quite 65 yards.

The howitzer, constructed by Schneider-Canet, is a quick-firing weapon with long barrel recoil, similar to the older types of this factory, and has therefore a great likeness to the French 75mm. (=3-inch) field gun M/97. In the firing position it weighs 65½ cwt., and it fires a shell weighing 88 lbs., with an initial velocity of 1,150 ft. and a maximum range of 8,720 yds. For firing the howitzer is placed with its wheels and the point of the trail, which has a folding spur, on planks; but in case of need it can also be fired from the natural ground without intermediate support. Special means for fixing, as provided for the French field gun, are in this case unnecessary. If minor changes of position are required, a small wheel is inserted in place of the spur, and this considerably facilitates the move, especially with the aid of the rope drum.

At the point of the trail a limbering ring is provided by means of which the leading howitzer is connected to the motor, the second howitzer to the leading one, and so on. For this purpose an appliance is fixed to the muzzle end of each gun-carriage, to enable the limbering ring of the succeeding howitzer to be attached thereto.

The howitzer has an appliance by means of which the barrel can be rapidly changed from the firing position to the horizontal loading position, or *vice versâ*. In place of a "collimateur" it has a telescopic sight, which is secured to the shield pins on the cradle.

If hostile fortresses in future warfare are not to cause undue delay to the advance of a field army, it is essential to confront them with heavy guns as rapidly as possible. This is one of the most important lessons taught by the Franco-German War, and all nations have accordingly made provision for the horsing of heavy batteries, which follow the field army at a certain distance. Part of these batteries will under certain circumstances be in immediate touch with the field army, as they may have to take part in its battles. For such batteries it will for some time to come be impracticable to replace animal by mechanical haulage. With the remaining (*i.e.*, mortar) batteries, however, horses could with advantage be replaced by traction engines. Possibly their first cost will be greater than that of horses, but certainly the cost of maintenance will be less. Had we possessed only about twenty such traction engines in

* The motor has an indicated horse-power of 35.

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1870 before Paris, the ammunition necessary for bombardment, the total weight of which was estimated by Lieut.-General von Müller at 1,425 tons, could undoubtedly have been transported in 30 days from Nanteuil sur Marne to the Park of Villacoublay (a distance of 18 miles). In that case the bombardment of Paris could have commenced nearly two months sooner.

Such traction engines would be of tar greater service in the defence than in the attack of fortresses. They would considerably reduce, if not entirely obviate, the necessity for the slow process of laying narrow-gauge railways. By this means also a freer choice could be made of the roads of approach; and portions exposed to fire could more easily be avoided, as such traction engines, especially if of light construction, can very well travel across country, a fact that has been proved by the train built by the "Allgemeine Elektrizitätogesellschaft" to the order of Lieut. Troost for the troops of occupation in S.W. Africa. Above all they enable the requirements in horses and men to be considerably reduced, which is of special importance inside a fortress. It would seem very desirable to provide such traction engines in peace time for all the more important fortresses, to take the place of cart horses and to serve for the training of a certain number of drivers. It is needless to say that this should not be done until extensive trials have first been made.

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SANITATION IN CAMPS.*

In the *Journal of the Royal Army Medical Corps* for November last appeared two articles,—*The Causation of Enteric Fever at Quetta*, by Lieut.-Colonel J. Battersby, R.A.M.C., and *Water Supply and Sanitation in India*, by Lieut.-Colonel H. S. McGill, R.A.M.C.—which contain much information that is valuable to officers responsible for the selection of camping grounds and for the sanitary measures to be adopted on their occupation; the necessity for such measures "is too often undervalued by military officers, both during peace manœuvres and on field service."

The articles should be read *in extenso*, but the following extracts may be found useful; to save space the usual omission marks are not given.

Conservancy in Camps.

In February, 1899, Colonel Battersby was ordered to Quetta as Special Sanitary Officer. "The previous year had been particularly unhealthy, as (with an average strength of 2,543) 232 cases of enteric fever had occurred amongst the European troops, with seventy-five deaths, the virulence of the disease being most marked during the usual period of seasonal prevalance, July to November. The cause of this outbreak was very thoroughly investigated, and was found to be undoubtedly due to the position of the old trenching grounds, which were situated to the windward of the barracks, about a mile to the north-west of the cantonments. The system of shallow trenches for the disposal of night-soil was wholly unsuitable for Baluchistan, where the average annual rainfall is about twelve inches. When the annual dust-storms commenced in May and June (more especially the so-called 'dust devils'), clouds of dust-borne germs must have been blown over the cantonments, inevitably infecting water, milk, and all articles of food and drink exposed to air and dust, as the prevailing wind blew directly from the trenching grounds towards the barracks.

At this time the Royal Artillery and left British Infantry lines were nearer to these shallow trenching grounds than the right British Infantry barracks, and were placed more directly in the line of wind which carried clouds of germs from these dried-up and dusty trenching places. In the eight years prior to 1899, 114 deaths from enteric fever occurred in the Royal Artillery and left British Infantry lines; while 32 deaths were registered from the right British Infantry barracks.

Lieutenant-Colonel Davies, R.A.M.C., the Sanitary Officer at head-quarters, stated: 'I feel convinced that this (infection contained in the air) has been the principal channel of its conveyance, and that the main

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source of the poison was the filth trenches, though latrines, Native and European, may have been concerned as well; the cessation of cultivation of the trench area, combined with the absence of rain in 1898, has, in my opinion, established the fact of aerial infection.' It seems unnecessary to remark that the system and the site previously adopted for the disposal of night-soil were at once changed. The infected area and shallow trenching grounds were, as far as possible, cultivated, and where this could not be accomplished, the dry and dusty surface of the ground was covered with litter, which was then burned, and every additional endeavour was made to destroy the *materies morbi* of the disease.

A new system of deep pits was introduced, and was found to answer admirably, pending the introduction of a water-carriage system and septic tank installation. The present site (at Sahabzada) for the deep pits is situated about three miles to the north-east of the British Infantry barracks, a point from which the wind seldom, if ever, blows towards the cantonments, and is approached by a good metalled cart-road. Each pit is 30 feet in length, 11 feet deep, and 7 feet in width, and receives all the night-soil (solid and liquid) of the cantonments for six days. The pit is filled up to 18 inches from the surface. A series of similar pits in line with each other are dug, each pit being separated from its fellow by a wall of clay about 2 feet thick, on the top of which a drain is cut 2 feet wide and 9 inches deep, which allows every possible overflow during wet weather to be discharged into the adjoining pit, and thus preserves the surface of the ground from pollution. These pits act as anaerobic chambers, as the surface of the contents is quickly covered with a thick scum of leathery consistence. Bacteriological action quickly reduces the solids to a liquid condition, while the hardy putrefactive organisms rapidly destroy the more delicate pathogenic ones. The latter are accordingly trapped, so to speak, in these pits, instead of being allowed to play their mischievous *rôle* in dry dust and shallow trenches. Besides, various gases are being continuously formed, which escape freely into the air. By this constant bacteriological and chemical action the contents of each pit practically disappear within a year, when the pits can again be used. A special conservancy establishment is located at these pits. A good supply of pipe water has been laid on, and from six standposts all the receptacles and Crowley carts are thoroughly washed before returning to the cantonments. This washing is done on a brick and cement floor, and the dirty water conveyed by a surface drain to cultivated land.

Notwithstanding the many sanitary alterations and improvements that had been effected during the previous two years, another outbreak of enteric occurred in 1900. This outbreak, unlike its predecessors, did not make its first appearance in barracks, but in camp. As a prophylactic measure, summer camps had been formed for young soldiers; one for Infantry was situated in a remote district, far removed from native villages, and provided with an excellent pure water supply; the other, for Royal Garrison Artillery, was chosen by the authorities as affording the best site for practice, being situated at a convenient distance from the artillery range. This camp was near Baleli, in the Bostan Valley, and here enteric fever began in the month of July. After the third or fourth

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case had occurred the camp was moved to a new site at a distance of two miles from the former. The water supply was above suspicion, and was obtained from an artesian well of 120 feet in depth; still the disease continued to spread. A noticeable feature of both these artillery camps was the marked prevalence of dust-storms and 'dust devils,' which daily blew into the tents. The season (June, July and August) was reported to be an unhealthy one amongst the natives, and on visiting the surrounding villages we found many Pathans and their children suffering from a form of fever indistinguishable from ordinary enteric. Here, then, was a possible solution of the problem, as owing to habits and customs inseparable from the native population, the dusty soil and streams of water adjoining their dwellings must have formed sources of actual infection. The dust from these villages must have been charged with enteric and other germs, as everywhere it was visible, mixed with dried fragments of fæcal *débris*. The conclusion was therefore forced upon us that it was from such sources of infection that the disease spread to European troops by means of aerial convection. A marked feature of the outbreak in camp was the apparent tendency to spread from one individual to another, more especially amongst those occupying the same tent. This seemed to be due to personal contact and direct infection from man to man, and probably to indirect infection through contaminated clothing, bedding, soil, or possibly by flies. In a dusty country the enteric bacilli are widely disseminated by the wind, infecting articles of food and drink, which, under the conditions of camp life, are necessarily more exposed to such infection. The common fly should also be regarded as a constant source of danger, through depositing bacilli from bed-pans, urinals, latrines, filth carts, shallow trenches, polluted ground, or articles of clothing soiled with infected urine or fæces. In camp, flies are ubiquitous and swoop down upon every article of food and drink exposed to their view. Unwashed raw vegetables, or fruits and vegetables washed in the wayside stream, must be looked upon with grave suspicion. The native bazaars are also most undesirable places of resort. There is grave suspicion that some of the cases occurring in barracks owed their origin to mineral waters from eating houses, where pollution might possibly have occurred through leaky water pipes. The common hawker, too, should be prohibited from selling his goods in camp or barracks.

With the experience of the artillery camp of 1900 fresh in our memories, we resolved to search for a new camping ground for the enteric season of 1901. About seventeen miles from Quetta a good site was discovered, remote from native villages, and provided with a sufficient water supply of excellent quality; although malarial fevers of a mild type were prevalent, enteric fever was conspicuous by its absence. In 1902 another summer camp was chosen at Mangal-Kot-Kotal, situated at a distance of twenty-four miles from Quetta, and also remote from villages. The water supply was excellent, and conveyed by means of 2-inch pipes from an adjacent mountain spring. Not a single case of enteric fever occurred. The men for these camps were specially selected, bearing in mind the predisposing influences of youth and of recent arrival

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in the country, as the period of greatest liability to attack for men is undoubtedly between 20 and 25 years of age.

These summer camps were not popular with either officers or men. The beneficial effects, however, were so marked in diminishing the number of admissions to hospital from enteric fever, that it was decided to search for a more popular site for the summer of 1903. About sixty miles from Quetta lies the pleasant hill station of Ziarat, situated at an elevation of nearly 8,000 feet, and about two miles distant was an excellent water supply, known as 'Lady Sandeman's tangi.' The site was sanctioned for one season as an experiment, and orders received to prepare a camp for 1,200 European troops, with the usual complement of followers and transport animals. The Sappers at once prepared an excellent road about two miles long, connecting the main road with the highest point of the camp, which was also divided longitudinally and across by two broad roads. Separate sites were now measured for half a battalion of each Regiment, and for the Garrison Artillery and Mountain Battery. In doing this, strict orders were issued that no trees were to be cut down, and that the tents were to be pitched between the juniper trees wherever most shade was afforded. I arranged that all night-soil should be removed by Crowley carts and deposited in deep pits, as we were doing at Quetta. For this most important purpose a suitable site was at once selected to the leeward of the camp, about a mile away. Sites for company and native latrines and urinals were also marked out, each latrine and urinal being supplied with a double set of glazed earthenware receptacles. No trenching whatever was allowed, and on the arrival of the troops, with their native followers, all conservancy arrangements were ready for immediate use. If these preparations are not made prior to the arrival of troops in camp the surroundings will inevitably become polluted. The adoption of the removal system for night-soil in camp enables the site to be handed over after three or four months in as clean and sanitary a condition as when first occupied.

Cook-house water should be regarded as sewage and removed to separate deep pits. Special Crowley carts and receptacles for the removal of cook-house water are reserved for this purpose and painted white. Ordinary washing water can be used for watering the plants and trees outside the camp. One or two small incinerators should be provided in suitable positions and all camp refuse burned in them. I have found an iron frame, somewhat similar to that used for the protection of young trees, with a grating near the ground, to act admirably for such purposes.*

* A subsequent number of the *Journal of the R.A.M.C.* contains the following note:—During the South African War . . . Capt. L. W. Harrison, R.A.M.C., devised a very simple means of effectually disposing of this material (refuse), which seems worthy of more extended application. On field service there is always an immense quantity of empty tins of all sorts and sizes; these should be collected together and stacked in a number of little heaps about 4 feet high; upon these heaps should be piled the miscellaneous combustible rubbish, and the heap then set alight. The tins serve the purpose of keeping a good air space between the ground and the rubbish, and so cause the whole heap to burn with a fierce draught, all the combustible material being reduced to white ashes in about four hours. The burnt tins can be used again. This plan takes much less time and labour than would be required to dig trenches and bury the rubbish; moreover it does not pollute the ground. Even in wet weather the plan may be carried out, though of course not so expeditiously.

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The ordinary leather *mussack* was not allowed in camp. Water was conveyed from the source already described by means of 2-inch pipes to specially constructed zinc reservoirs, impervious to rain and dust, over which a guard was placed for the protection of the supply and prevention of waste. From these reservoirs the water was carried to different parts of the camp by mules supplied with galvanised zinc *pakhals*, covered with thick felt, which, when damp, kept the water cool. Each unit brought a section of its regimental dairy from Quetta, so that all butter and milk used in camp were under constant supervision. Transport animals were located at the foot of the hill, and a separate branch water-pipe laid on for their use. Here, too, was chosen a suitable place for the slaughter-house, with special conservancy arrangements, including a small incinerator for the destruction of diseased livers, etc., a large percentage of which were affected with fluke. An excellent site was also selected for the commissariat supply depôt and bakery. Field-ovens were used, and the bread baked was invariably of excellent quality.

Special sanitary rules were drawn up and printed for the use of each company cook-house, which prevented slops and refuse from being thrown about. The neglect of this simple order is the chief attraction for the swarms of flies so frequently seen in and about cook-houses. During the season two officers contracted enteric fever; one from drinking water at a distant village while out shooting, the other owed his illness to having drunk water from an unknown source on the march from Quetta; but not a single case occurred among the men. The season was an exceptionally unhealthy one with the civil native population, as typhus fever and cholera were prevalent from May to September."

Colonel McGill writes with respect to

PURIFICATION OF WATER.

"On active service troops often suffer severely from water-borne diseases, and various plans have been suggested to provide them with a pure drinking water. It is generally necessary to clarify the water before making an attempt to purify it, and this can easily be done by sedimenting with alum or straining through a cloth or Maignen's filter. In order to render water innocuous it has been proposed to sterilise it by means of chemicals; but the results obtained under the conditions of active service have so far not been satisfactory, and the methods have been reported as unreliable and cumbrous. Lately, Vaillard has sterilised water in ten minutes by means of tabloids containing (*a*) potassium iodide and sodium iodate, (*b*) tartaric acid, and (*c*) sodium hyposulphite.

The Pasteur-Chamberland, Mallie and Berkefeld filters can efficiently sterilise water; but they have not proved satisfactory when tried with moving bodies of troops, as portions of them are easily broken, leakage often occurs, allowing the sterile and raw water to become mixed, and the filtering medium requires to be frequently cleaned and sterilised, both of which operations are liable to cause minute lesions of the surface of the bougies, with consequent impairment of the germ-stopping power of the filter. The most suitable filter for use on field service is the

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Berkefeld. No reliance can be placed on the efficiency of their sterilising powers unless frequent bacteriological examinations of the filtrate can be made.

Only by boiling can water be rendered absolutely safe, and unfortunately the process is often difficult to carry out on active service. Two forms of field sterilisers are at present highly recommended. One, the Forbes-Waterhouse water steriliser, is the pattern used by the American Army. This apparatus weighs 90 lbs. when packed, and can deliver hourly 25 gallons of sterile water, having a temperature 15° to 20° F. higher than that of the raw water, with the consumption of only 8 ozs. of kerosene oil. The apparatus should be worked under shelter, as wind easily disturbs and extinguishes the flame of the lamp. The second pattern of steriliser is Dr. Leigh Canney's, which consists of a copper cylinder, the bottom of which is involuted into eighteen pockets, so as to increase the area of its heating surface. The whole apparatus weighs 60 lbs. and can sterilise 6¼ gallons of water in from nine to thirteen minutes, according to the temperature of the water, with the consumption of about 8 ozs. of petroleum.

Standing camps* should be provided with approved water which has been sterilised by means of either of the above apparatus. Troops on manœuvres and on the march should also be supplied with sterile water. As carts can be used on such occasions, the necessary apparatus for a regiment—four sterilisers and two 200-gallon storage tanks—may easily be sent on ahead of the troops, and sufficient water sterilised in four hours. It is a far more difficult matter to provide moving bodies of troops on active service with sterilised water. There is no doubt that troops should be supplied with some portable and rapid means for sterilising water in the field, and I think the only method will be to provide each man with sterilising tabloids and instruct him to invariably use them with any water of doubtful character. In addition, every 200 men should be provided with one steriliser, in the charge of specially trained men, which could supply them in four hours, while encamped, with sufficient approved water for their water-bottles and carts or *pakhals*; though in the case of troops marching all day, camping late, and starting early next morning, the boiling of a sufficient quantity of water to meet requirements will often be found a very difficult matter.

The Forbes-Waterhouse steriliser is, I think, the best pattern for use in the field, as it has several advantages over Leigh Canney's, the lightness of which is nearly counterbalanced by the weight of the fuel required to be carried for its operation. Besides, the only type of steriliser which will be of practical use on the field is one that can supply the thirsty soldier with cool sterile water in the shortest possible time, and the Forbes-Waterhouse apparatus meets this requirement better than any other that I am acquainted with. Drinking water should always be carried and stored in camp and in the field in covered metal vessels, which must be provided with taps and frequently cleaned. Leather *pakhals* and *mussacks* must never be employed for these purposes, as

* Except when pure water is otherwise assured.

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they are generally dirty and impossible to clean with any degree of certainty.

In connection with the incidence of the water-borne diseases—enteric, cholera and dysentery—among troops in camps and on field service, it should always be kept in mind that the men will be less susceptible to them if the camp area is carefully sanitated, all refuse removed and burned, excreta buried deeply and covered several times a day, trenches frequently disinfected, all cases immediately isolated, and their clothing, bedding, feeding utensils and tents disinfected.

CAMP SANITATION.

Cooking Places should be placed on the flank of the camp which is opposite to the side nearest the trenches. The surface around kitchens should be cleared for a radius of at least ten yards and kept scrupulously clean. Kitchen refuse must always be kept separate from ordinary dry rubbish, and neither it nor the sullage water should ever be thrown on the ground. In temporary camps occupied for only one or two days, cook-house garbage and slops may be cast into separate small pits about 2 feet deep, which are to be dug outside the perimeter. The earth at the bottom of the pit for slops should be well loosened for a depth of a couple of inches and a little loose earth should be thrown over the slops and dry refuse several times a day. All kitchen refuse pits should invariably be completely filled in before the troops march out of camp. In standing camps all cook-house garbage and slops should be deposited in separate covered zinc or tin receptacles, emptied at least once a day and disinfected by chlorinated lime or by burning some dry litter in them. The ground on which the receptacles are placed should be well beaten down and kept clean, the sites being frequently disinfected and moved from time to time.

Refuse in any form should never be permitted to lie about a camp area. A considerable amount of dry rubbish and litter can be usefully disposed of by burning it in the latrine and urine trenches and over soiled areas of ground, and so utilising it as a disinfectant. A convenient and effective method for disposing of refuse in standing camps is to throw up a small bank 2 feet high round a horseshoe-shaped piece of ground, on which the litter is first allowed to partially dry and then thrown evenly along the outside of the bank and ignited. The fire burns almost continuously and no nuisance is caused. On no account should litter or refuse ever be spread out on the ground to desiccate under the influence of sun and air, as a nuisance will certainly be caused, flies will be attracted, and there is a great risk of food or water becoming contaminated. All garbage and offal should be removed daily from kitchens and slaughtering places and burned at some distance from the camp. In the stationary camps Horsfall's moveable destructors might be employed for the destruction of refuse—when fuel is easily obtainable.

Latrines and Urinals.—It is always better to dig a few long trenches than a number of small ones, as they can be more easily supervised, and soil pollution is more limited. All deep trenches must be filled in when the contents are

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about 2 feet from the top, and the earth should be well banked up over them so as to clearly mark their sites. To ensure the trenches being kept in a sanitary condition, the men should be particularly instructed to throw some earth over their dejecta before leaving the latrine, for which purpose a few scoops might be provided. The sweepers should be made to cover all exposed excreta by throwing a little loose earth into the trench three times a day; they should allow no soiled paper to blow about. A shallow drain should be dug on the higher side of the latrine to prevent surface water entering the trench, which, if possible, should be sheltered with a light thatch roof. All latrine and urine trenches should be daily disinfected by burning in them a layer of dry litter three or four inches thick. To prevent unnecessary surface pollution of the camp area, night latrines and urinals should be provided in all camps. In standing camps they ought to be worked on the removal system, the receptacles (empty kerosene tins) being taken into use at nightfall and removed at *reveillé*, when the sites on which they were placed should be cleaned and disinfected with burning litter or chlorinated lime solution (1·5 per cent.). This system of removal works very well if carefully supervised, but is far inferior to the American Army trough method, in which milk of lime is utilised as a disinfectant.

When field operations have to be carried out in a country with an Arctic winter, all excreta and garbage from a standing camp should be disposed of by cremation. Otherwise, when a thaw sets in the nuisance caused by the exposed filth, which the frozen state of the ground prevented being covered at the beginning, would be appalling, as was demonstrated in Northern China.

Infectious Diseases.—Every large standing camp should be provided with a Thresh's portable emergency steam disinfector, or an Arnold's steam steriliser, for the disinfection of clothing belonging to cases of contagious diseases.

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REVIEWS.

DER KRIEGSSCHAU PLATZ IN OSTASIEN.

By Major Joseph Schön, 1904.

This is a very serious topographical description of the theatre of war, 310 pages, with a general map on a scale of 1 : 1,500,000, a map of the Liao-tung peninsula at 1 : 100,000, a skeleton general map (showing the mountains by thick black lines) at 1 : 5,000,000, and plans of Vladivostock, Mukden and Liao-yang. It has been compiled mainly from Russian and German sources.

The book is divided into three main parts, Korea, Manchuria and the Russian Coast district; and besides the topographical features, deals with the climate, population, transport, routes, inhabited localities, resources and strategic conditions.

The road up the east coast of Korea to Vladivostock does not appear to be promising. From Gensan onwards it is continually ascending and descending the numerous ridges, which run towards the coast at right angles to the watershed and are only separated by very narrow valleys. It crosses numberless torrents with steep banks, and in some places is only about a mètre wide. It is full of large holes washed out by rain and covered with stones and boulders. In many places the gradients are too heavy for wheeled traffic. There is plenty of water, but little firewood.

The spelling of the place names is Teutonic; it is difficult at first to recognise old friends like Pingyang and Wiju as Pöngjang and Widschou.

THE RUSSO-JAPANESE CONFLICT; ITS CAUSES AND ISSUES.

By Dr. K. Asakawa, Ph.D.—(Constable. 7s. 6d.).

This is a diplomatic history of the causes of the war, presented with a logical thoroughness that reminds us of the military operations of the author's countrymen now in evidence in Manchuria.

Although the book bristles with references to Bluebooks, and gives *in extenso* the various conventions, agreements and treaties which have been negotiated in the Far East during recent years, so that it is a valuable work of reference, yet the matter with which it deals and its

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style render it almost a romance; and we confess that once having taken the book up we did not lay it down until it was finished.

An introductory note deals with Japan's economic interests in Manchuria and Korea; her dependence on those countries for food supplies and for markets for her manufactured goods; the advantage of her short sea route to them over Russia's long land line; and the impossibility of Russia being able to compete on even terms. This note is the only dull part of the book and may be omitted. Chapter I. is headed "The Retrocession of the Liao-tung Peninsula"; but it actually commences at the year 1860, when Russia, taking advantage of China's defeat at the hands of the allied forces of England and France, definitely annexed China's vast territory lying between the Ussuri river and the Pacific. The dramatic story of Russia's gradual advance southwards and her unscrupulous use of opportunities are traced to their culminating point in the failure of her diplomacy when she at last met a nation prepared to defend its liberties and rights with its blood.

The author treats his subject with impartiality and moderation. He thinks, no doubt rightly, that had negotiations remained in the hands of the thoughtful men at St. Petersburg instead of those of "that executive officer of great talent, but strategist and diplomat of unknown value, Admiral Alexieff," the present war might have been avoided.

The interest of the book is increased by good portraits of Count Cassini, Count Lamsdorff, Count Katsura (the Japanese Premier), M. Lessar, M. Pavloff, and other actors on the diplomatic stage of the Far East.

THE RUSSO-JAPANESE WAR.

By T. COWEN.

The author has spent fifteen years in the Far East, and was one of the War Correspondents of the *Daily Chronicle* from February to May, 1904, when, owing to the severity of the Censorship, he ceased sending his despatches, but still remained at the seat of war.

The book contains the best general account of the war up to the battle of Liao-yang which has yet appeared, and much information which has not been given elsewhere; *e.g.*, when Japan was considering whether Russia's action on the Yalu would prove a *casus belli*, the Russian Minister to Korea, M. Pavloff, who ought at that critical time to have had no thought for anything in the world except diplomatic problems, was chiefly concerning himself with the friendly relations of Madame Pavloff, his wife, and Colonel von Raben, his Military Attaché, and at the last actually fought a duel over the matter and was slightly wounded.

The author makes an interesting comparison between the Liao-tung Peninsula and the S.W. extremity of England. "The land lies in a very similar position and the nature of the coast line bears some resemblance.

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If Mount's Bay had three or four miles of anchorage inside of the island, and if St. Michael's Mount were three or four miles long and connected with the mainland at all states of the tide on one side, it would resemble Port Arthur. Land's End and the Lizard are not at all unlike Laoteshan and the headlands towards Dalny. The whole coast is just about as rocky and rugged. . . . On the north side of the peninsula the parallel is nearer . . . but the port of Newchwang is on a dead flat instead of being on rising ground like Bristol."

Mr. Cowen, after his war experience, holds that "Naval force is the most important as a first line of defence for an island nation, or a first step in attack, but as a rule is merely auxiliary in bringing about a final decision."

The book is well illustrated by photographs and drawings by a Japanese artist, but the plans of Port Arthur and Liao-yang are indifferent.

A SECRET AGENT IN PORT ARTHUR.

By WILLIAM GREENER.

The author was in the employ of *The Times*. His work is interesting, but, while giving much local colour, he tells us very little about the war. He reached Port Arthur from Peking *viâ* Mukden on the morning of 9th February, 1904, just after the first Japanese attack on the fleet.

"The torpedo attack and the subsequent bombardment had astonished the Russians; the only word which expresses adequately the condition of the authorities is 'flabbergasted,' for they were rendered defenceless by their unlimited bewilderment. A few well-armed, daring troops, landed immediately after the torpedo attack or simultaneously, would have captured the town, the staff and the heads of departments, and might have carried at least one of the forts."

Towards the end of February Mr. Greener was discovered and turned out of Port Arthur. He went to Newchwang (Yingkow), where he seems to have remained, sending reliable Chinamen out into the theatre of war to get news. He gives specimens of the bulletins he received. "I see four Russian guns at Yuen-pao Mountain; I see many troops of Russian there; I see guns at An-chu and troops. . . . There was bobbery." "Russian soldier cross Yalu river. Come back this side. He no wait. He go thereby in small sampan; no can; boat lost. Russian men all lost. . . . ."

The most valuable part of the book is the account of the Russian and Japanese troops whom the author was able to observe during their respective occupations of Newchwang. Any Russian sentry could be passed by replying K'Chortu (to the devil). "The Russian officers and the Russian troops from the British standpoint of to-day were licentious, dissipated and immoral, as well as rough to occasional brutality. . . .

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When they left they took with them their women, their drink, their dirt, their noise—and the goodwill of the bulk of the foreign residents. Judged by the standard of to-day they lack seriousness, refinement and education. . . . As soldiers they most lack ardour for their profession and the courage that comes from an intelligent conception of duty."

"The Japanese appear to possess a talent for organization, which amounts almost to genius. In a few days the visitor would have believed that they had been in military occupation of the treaty port for months. . . . There was a censor appointed and he could always be found."

"In the game of life Russia disregards all the rules which Western civilization has decreed to be right. In politics, in commerce, in law, in the big things and the little things of life, Russia is a law to herself. The Japanese, on the contrary, have accepted the Western standard." Which then is the peril?

Mr. Greener has many hard things to say of the British consuls in the Far East. "Reared in a cold storage establishment, grappling all their days with Mandarin Chinese and fine print," is his description of them. Their offices are full of doors marked 'Private' and 'Judge's entrance,' and other legends forbidding your progress." On leaving one "you turn to see if the motto under the British coat-of-arms does not read 'Non possumus'; and you wonder what the Consul does besides sentencing British subjects to deportation." "To all enterprise he is a passive resister." We await the Consuls' description of Mr. Greener.

PORT ARTHUR: THREE MONTHS WITH THE BESIEGERS.

By FREDERIC VILLIERS.—(7s. 6d. Longmans).

Mr. Villiers, after waiting some months at Tokio, was permitted to join General Nogi's army as representative of the *Illustrated London News* in August, 1904. His book contains much about his lodgings, his meals, his dreams, his illnesses, his servant and his fellow correspondents; but very little about the military aspects and events of the siege. The map is an extremely poor one. There are 37 illustrations:—Mr. Villiers being presented to the Emperor of Korea, Mr. Villiers' servant, Mr. Villiers' horse, Mr. Villiers' breakfast, Mr. Villiers' sleeping bag, Mr. Villiers' invitation to dinner, General Nogi at lunch, Admiral Togo after lunch, General Tsuchiya's outspread left hand and the right half of his face, a sketch of the bamboo hand-mortar (we seem to remember that Major McMunn made one of these at a minor siege, inside, some years ago), and some half-dozen sketches of the environs of Port Arthur are alone of military interest.

N.B.—The Japanese call Port Arthur Ryo Junko..

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FROM TOKIO THROUGH MANCHURIA WITH THE JAPANESE.

By L. L. SEAMAN, M.D., LL.B. (Major and Surgeon, U.S.V., in the Spanish-American and Philippine Wars and with the Allied Armies in the Boxer Campaign in China).

In Parliamentary language the title of this work is misleading; by the writer's own confession he did not go through Manchuria and was never with the Japanese forces. On the 98th page of his 268-page book he leaves Japan for the more congenial atmosphere of Chefoo, where, to use his own words, "the most unconscionable band of liars that ever existed seemed to have their headquarters." He made one trip to Newchwang, was there when the Japanese occupied it, and went out as far as Hsin-min-tong under Chinese escort; this, together with hearing the bombardment of Port Arthur, seeing a mine floating in the Gulf of Petchihli, and meeting a Russian who had the base of a shrapnel in his back, is about the sum of his war experiences.

For those who wish to know how the 4th of July is kept in Japan; how when Marshal Oyama left, "amid the tumult of 'Banzais' there was heard the shrill voice of an American woman"; of the doings of the Volunteer American Nurses who were "not familiar with the Japanese language"; and of the efficiency of American Consuls, the book may be of interest. But it is of no use to the student of the military history of the campaign.

There are some remarks which hardly bear the impress of accurate observation in the account of the author's visit to Wei-hai-wei, "where the British have their military zone of occupation in the north." In this "fortress" he made the acquaintance of two officers of the British garrison, Colonel Bowers and Major Muspratt. He adds Maru (which is only used with the names of merchant ships) to the unfortunate battleship *Hatsuse*.

There are illustrations of the Chinese junk on which the American newspaper correspondent Etzel was killed; of "the harbour of Chefoo, showing the American Consulate"; of "the evacuation of Newchwang, the American Consulate in the distance"; of the author and his companion in various positions and in various company, including that of Li Hung Chang (who died in 1900).

WITH KUROKI IN MANCHURIA.

By FREDERICK PALMER.

Mr. Palmer is an American correspondent, who joined General Kuroki's army a week before the battle of the Yalu. His narrative closes with the battle of Liao-yang. Although not precisely military history, it contains, thanks to his keen and trained powers of observation, a vast

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quantity of information with regard to the Japanese army in the field and the Russians as an enemy.

The author frankly admits the difficulties which beset both the military attachés and the correspondents. It was impossible to allow them much freedom of movement because "let them appear on the line of outposts and they would be taken for Russians." The average Japanese cannot tell one European from another any more than the average Englishman can distinguish a Japanese from a Chinaman or Korean, with hair cut the same way and wearing much the same kind of clothes. "So the attachés ride behind the staff and the correspondents behind the attachés."

The account of the battle of the Yalu, written at Antung five days afterwards, is picturesque, but it unfortunately lacks a map, as also do the accounts of the other engagements. "So well did the Japanese fool their enemy that they struck the Russian when he was unprepared and never sent a man against him when he was prepared." "With 40,000 victorious soldiers in their rear the Russians moved as one vegetating Siberian garrison would move from an old to a new post," with the soup-boilers and their broad heavy carts designed for the Steppes. The captured Cossack swords were dull-edged!

To the Japanese army "all is team play; nothing is for any gallery, unless it is the international gallery. . . . As no corps, no division, no regiment stands out with the conspicuousness common in other lands, so does no general. The private is a private; the officer an officer, impersonal." "A Japanese general knows that any force, however small, will stay where it is placed—stay, alive or dead. One company is as much like another as peas in a pod; no special units, no Rough Riders, no King's Own." The Japanese use individual fire; "When the Russians answered, it was always in volleys . . . they fire as they march, in a flock. . . . They aim in the general direction of the enemy, with the result that they fire into the sky." In the early morning attack on the Motien pass the Russians advanced with drums beating in the front line.

Mr. Palmer points out the inferiority of the Japanese field gun to the Russian. "It is of an old pattern, the range is 1,000 yards less than the enemy's, the shell 3 lbs. lighter, the muzzle velocity 300 feet less per second; and it can fire only one shot, where the Russian gun fires two or three."

The methods of the generals are neatly contrasted. At Tensuiten Keller stood in a battery where he could see, his staff with him, exposing "the very spinal cord of his force"; while Kuroki "sat in safety, his staff around him, in touch with all his units" by telephone and messenger. "Keller was a heroic spectator, but not a modern commander . . . he was as much out of place as the guard of a train on the cow catcher. He was simply a magnificent personality; and nowadays, personalities win decorations and machines win victories."

Mr. Palmer is of opinion that there is some danger of the Japanese thinking other Occidental armies are as stupid and slow as the Russian.

The book is illustrated by 20 good photographs, including one of General Kuroki and his staff, but (as before noticed) has no maps.

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THE ROYAL ARTILLERY GAZETTEER.

(R.A. Institution, Woolwich. 9½ × 6. 1s.).

This book of some 130 pages gives information about places abroad where Batteries, Companies and individual Royal Artillery Officers are stationed.

A frontispiece, folded so as to open clear, gives a list of 24 questions under the headings Military and Regimental, Communications, Climate, Uniform and Plain Clothes, Pay, Leave, Sport, Furniture, Horses and Vehicles, Servants, Dogs, Languages, Amusements, Education, General Remarks. The book itself contains the replies to these questions, numbered correspondingly to the frontispiece, for some 90 stations, of which the majority are in the East Indies. Appendices give respectively Customs Duties in Canada and Rates of Indian Pay and Allowances.

The information has evidently been carefully collected and checked, and a great part of it would be useful to officers of all branches of the army.

IN THE PATHLESS WEST WITH SOLDIERS, PIONEERS, MINERS AND SAVAGES.

By FRANCES E. HERRING, *Author of "Among the People of British Columbia," etc.* 8vo. 240 pp. (T. Fisher Unwin, 1904).

This book is a curious medley of stirring incidents. It begins with the voyage of the good ship *Thames City* in November, 1858, from Gravesend with a strong company of Royal Engineers (120), and half as many more women and children, destined for British Columbia.

The men had volunteered to do the pioneer work of this new colony, and the *Times*, in a leading article, paid the Corps a compliment upon the occasion :—

"Whenever Her Majesty's Government want a body of skilful, intelligent, and industrious mechanics to perform any task requiring peculiar judgment, energy, and accuracy, such as the arrangement of a Great Exhibition, the execution of an accurate National Survey, and so on, or even the construction of houses, roads, and bridges, in a new colony, they have only to turn to the Corps of Royal Engineers and they find all the material that they want."

In a short preface the author expresses her obligations to Colonel Wolfenden (who was one of the Company of Royal Engineers that went to British Columbia on board the *Thames City* in 1858. and whose honourable career in British Columbia was referred to not long since in this *Journal*) for the loan of *The Soldiers' Gazette and Cape Horn Chronicle*, a weekly newspaper issued regularly during the voyage to Vancouver, extending over five months.

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The various incidents of the voyage are described, the ceremony on crossing the line and the amusements on board. The ship put in to Port Stanley, in the Falkland Islands, where the redcoats quite upset the quiet and decorum of that remote and staid little place. After rounding Cape Horn the detachment came in for the usual cold and tempestuous weather so common in those parts, and encountered a big storm. While working up the coast of Chili the crew obtained drink from the steward and mutinied. The Sappers were called to arms and the mutineers were clapped into irons and landed at Valparaiso, a day's sail away, the Sappers working the ship. Here a fresh crew was shipped and the voyage continued without further incident to Esquimalt.

A detachment of Royal Engineers, under Capt. Parsons, had left England by the steamer *La Plata* two months before the *Thames City* sailed from Gravesend, and was stationed at Fort Langley, up the Fraser River. Thither the later detachment also proceeded, until Colonel R. C. Moody, R.E., the Governor, had the whole of them encamped lower down near the site of the capital, New Westminster.

A print is given of the R.E. Camp above New Westminster in 1862, and there is a pretty view of Esquimalt. The book contains many amusing stories of the new colonists, and a description of life in the city.

"Sunday was quite a gala day in the little town, for then the military, splendid in their red coats, shining boots, and bright buttons, paraded to church, headed by their band, and all the citizens came out to see them and enjoy the music. Indians by the hundred stood around, mostly wrapped in blankets and without anything on their feet. They far outnumbered the little band of whites.

"Up the hill, into the little wooden church marched the soldiers, followed by the rest of the congregation, for few entered until they had seen the sight of the day. The officiating clergyman was the Rev. John Sheepshanks, the present Bishop of Norwich, who lived in a little log cabin near by.

"It was great to watch the young married women and the marriageable girls come mincing in, tossing their heads at every measured step, screwing their mouths into a 'prunes and prism' expression, and putting on 'French and frills' generally. Yet one of these latter young creatures, from fourteen to seventeen years of age, would perhaps by another Sunday be wending her way over mountain and prairie on horseback to the home of a well-to-do husband, whose acquaintance had been made within the week, and who had journeyed down with the express purpose of taking back a white wife."

After the colony had attracted a certain number of colonists, the people began to grumble at the cost of the military, and it was decided in 1863 to bring home all the Sappers who did not want to take their discharge and settle in the colony. Those who remained received each "160 acres of land free and unencumbered, wherever they chose to select it, with an honourable discharge. . . . Most of the married men remained; many of them had wealthy sons-in-law by this time, and grandchildren born in the colony, although they were still in their prime themselves. The camp, indeed, had added bravely to its numbers.

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. . . But few have regretted their stay; and if they have, it has been their own fault, not that of the country."

The second half of the book is mainly about the Indians of Fraser River and the far North, their habits and superstitions. This is well told in relation to actual braves and squaws, and to a pathetic story of a little English boy named Billy Hilyard.

Billy is first seen embarking at Gravesend with his stepfather, a surly sapper, one Billings — Billy's mother dies in child birth in the storm encountered after rounding Cape Horn, and the infant dies too. The bodies are buried at sea:—

"There was a grating slide, a splash, a wild cry from a lonely child, and—'Rest for the weary.'

"Poor little Billy crept away to the dog kennel unnoticed, and clasping his arms around the neck of one of his cannie friends he cried himself to sleep. The other one lay near him and kept him warm.

"The storm rose again, the hatches were battened as before, and only the unconscious child was left on deck.

"Whew! how the wind shrieked, the good ship groaned, and the subdued and saddened 'citizens' below clung to their berths. . . .

"Now the pair of dogs were thoroughbreds, and were coming out on consignment, so they were provided with a good watertight kennel, well lashed to the deck; but the late storms had loosened these lashings, and a sea struck the good little ship with such force that she shivered from stern to stern like a living thing. As it left it carried kennel, dogs and sleeping child with it. The progress of the ship had been stayed by the shock, and she stood almost on her beam ends, so when the wave returned it brought back the kennel, one dog, and the child, his arms still around its neck, his tear-stained face still pillowed on the shaggy coat. The kennel was jammed in in such a way that there was no danger of its moving again.

"'My God!' ejaculated the big, burly mate, who had watched the return of the kennel, and had looked, never expecting to find anything, inside. 'It's the poor little chap whose mother was buried last night, and one dog!'"

Billy was taken charge of by the wife of Sapper Middleton; and when, five years later, she and her husband returned to England, he kept house with his churlish and drunken stepfather, who led him a miserable life. At last, one night he ran off, was seized by the Indians and carried away to the far North. Whether the story of his life among the savages be fact, or partly fact and partly fiction, the author has succeeded, in her description of the boy's wanderings with the Indians, in evolving an interesting narrative of thrilling adventures in which are many cruel and revolting deeds. How Billy escapes must be left for the reader to find out. The book is pleasant reading and will while away a spare hour or two.

ROBT. H. VETCH.

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NOTICES OF MAGAZINES.

Army and Navy Chronicle.

March, 1905.

This periodical, established in January, 1900, is now brought out on new lines as an illustrated Naval and Military Magazine, published on the 2nd or 3rd Friday of each month so as to catch the Indian and Colonial mails. Its dimensions are 11 by 8½ inches, a very convenient size, and its price 6d., post free 8d. The office is at 111, Jermyn Street, St. James', S.W.

The letterpress of the March number contains articles on Military Cross-Belt Plates, the Yeomen of the Guard, Some Famous British Naval Exploits, the Romance of Regimental Marches, Burney's School in the Seventies, and lists of the current stations of Military and Naval Units. The illustrations include:—The Royal Visit to Portsmouth, Lieut.-General Sir J. French and Staff of Aldershot Army Corps, the upper deck of H.M.S. *Talbot* (1st class cruiser), the Yeomen of the Guard, types of Cavalry Drummers, views in Portsmouth Dockyard, and reproductions of some old mezzotint engravings.

Bulletin of the International Railway Congress.

February, 1905.

The two sections of the February number aggregate some 600 pages of reports to be presented at the Washington session. Hence even to skim the contents has taken some time, and it is impossible to extract the essence of all.

There are two reports on *Concrete and Imbedded Metal*, containing a mass of information both as to the practical and theoretical employment of this system of construction. There seems no doubt that for Railway purposes the use of armoured concrete is economical, particularly as the maintenance cost of bridges is very low.

Attention is drawn to the Considère system, in which cross armouring is replaced by continuous hooping, *i.e.*, a helical arrangement of the imbedded steel, affording great resistance to compressive forces. Retaining walls of *Béton Armé* are stated to be more satisfactory than masonry, particularly if the ground is of a shifting variety; the weight of the earth

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itself can be utilised to bear on a horizontal ground plate to which the thin face is anchored by armoured ribs. (Such walls have been used at the Southampton Docks). An interesting point is that the cement covering has now been proved to prevent rusting. It is even possible to establish that a rusty rod when imbedded in concrete very soon has a bright surface again.

Professor Hatt, of Purdue University, has made a series of experiments and deduced a formula as under for concrete steel beams:—

$$M = Kfbh^2;$$

where M is resisting moment in inch-pounds;
P is percentage of steel in cross section in lower flange (not to exceed 3);
b is breadth of beam in inches;
h is depth of beam in inches;
f is tensile strength of concrete in pounds per square inch;
u is fractional depth of the steel from the top of the beam;
K is a constant which is as follows:—

For 1:2:4 stone-concrete beams

$$K = (\tfrac{1}{3} + (\tfrac{7}{4}u - 1)\,P)$$

or

$$M = (\tfrac{1}{3} + (\tfrac{7}{4}u - 1)\,P)\,.\,fbh^2.$$

Book-keeping.—Here again we have two reports, one for all countries except America and Russia by the Chief Accountant of the Kaiser Ferdinands Nord-Bahn, and one for America by the Chief Accountant of the Southern Railway. The subject has been approached from quite different standpoints in the two reports, for, whereas the former discusses principles of the accounting scheme, the latter practically consists of a detailed description of a typical American system. It must suffice to note some points from the former report, which naturally refers mainly to Austrian methods, and these have already received some notice in the *Journal*.

Government Railways naturally proceed according to some sort of Budget Estimate; but it is practically indispensable that those items which vary according to the traffic should be left more or less indeterminate in making the forecast; there are cases where, owing to the way in which the Budget is drawn, a rush of traffic requires Parliamentary authority for the expenditure involved to meet it! At the same time it is necessary that there should be some central check on payments, *i.e.*, no account should be paid until it has been checked and authorised by a responsible official; but it is not necessary to centralise the cash. The writer notes with surprise that, while in England cash is banked locally, payments are made by travelling officials, whereas it would appear practicable to authorise payments against the cash paid in by Stations locally.

It is most important to frame a good system of grouping together expenditure accounts. These may be made up (*a*) by posting all the vouchers under different heads, (*b*) by making the departments each prepare classified summaries, or (*c*) by compiling an account for all

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departments in a central office. In this latter case all the vouchers are posted to an expenditure suspense account, and this is afterwards made to balance with the monthly accounts.

Certain suggestions are made for the simplification of Traffic accounts at Stations—*e.g.*, the use of "Franking stamps" for parcels, thereby eliminating a vast amount of clerical labour—the checking of accounts of the Despatching and Receiving Stations together (accounts being sent from one station to the other), thus eliminating Abstracts to headquarters—the suppression of the Waybill, the consignment note only accompanying the goods, and despatched and received Registers shewing charges being kept at each end. (This is being done on the German Lines). It is considered sufficient under this method to confine the audit check of charges to occasional items.

The principal difficulty in accelerating the division of revenue is the complicated basis upon which rates are made up. Attempts have been made to group the traffic and divide the receipts according to certain co-efficients based on experience. "This method of division does not involve one-tenth of the work necessary to exact calculations. It appears, moreover, that the results differ but little from those obtained by exact accounts."

An important point is that the power to authorise expenditure and to authorise payments should be kept separate.

C. E. VICKERS.

CENTURY MAGAZINE.

March, 1905.

THE NEW SIEGE WARFARE AT PORT ARTHUR.—By Richard Barry (American correspondent).—This is a really valuable article, as it gives many important details with regard to the siege.

One morning in August General Nogi stood before his battalion commanders at Port Arthur with a pick in his hand. Its nose and heel had been worn away until the shank of rusted iron resembled an earth-dappled cucumber. Fondling it, the general said:—"Take a lesson from this Russian pick. Your men must dig. They are too eager to ask 'Why intrench to-night when we are going forward in the morning?'"

Nogi here went to the heart of the problem. It had cost him 25,000 men to learn that the Military Engineer must precede siege assaults, as his brother, the Civil Engineer, precedes rapid transit in New York.

Mr. Barry deals with the artistic Japanese methods of "invisibility"; how they made Kaoliang screens and carried away to the rear all the earth excavated from saps and parallels, making no parapet whatever. "As fast as the earth was displaced, they carried it with gabions and bamboo stretchers through the zigzag lines behind the mountain range which concealed their guns."

The story of the bringing of the twenty-six 11-inch howitzers up to the

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front is well told. "Under each gun was laid eight feet of concrete," in really permanent emplacements.

"For the first time in history armies battled under search lights," and a strategy in the use of the lights was evolved.

The bamboo gun for grenades, the dynamite wheel, the sap-head shield, the bamboo grenade lift, scaling ladders, bombproofs, telephone service, and many other matters are touched upon.

KRIEGSTECHNISCHE ZEITSCHRIFT.

Year VII.—No. 7.

SPARK TELEGRAPHY AND ITS IMPORTANCE FOR THE ARMY AND NAVY.—This comprehensive article on wireless telegraphy deals with the subject from a very elementary standpoint, and would be specially useful from an instructional point of view. It can be followed by anyone having the merest smattering of electrical knowledge.

Without going into complicated details about instruments the writer gives a simple description of the "tuning" system; he gives the various *rôles* which wireless telegraphy may be expected to play on land and sea, and states that, owing to the distribution of the "waves" in all directions, it can never be expected to entirely supersede ordinary telegraphy.

WAR TECHNIQUE AND TROOP LEADING.—Specially interesting in comparison with what is happening in our army at the present time.

The writer states that a proper organisation and training of the technical troops is of the utmost importance to ensure their proper use by a leader in war time. He lays down the following principles:—

(*a*). The most important considerations are:—

i. The peace and war organisation of the troops should be the same.

ii. Rearrangements of the peace organisation for immediate use in the field must be prohibited.

iii. The latest Reservists should be recalled when first making up the troops to war strength.

The demands on technical education are so great that it is quite impossible to train the men in all branches of their duties; one must be content if each unit—company, section or detachment—is capable of performing any technical duty. The result is that specialists are trained for specially difficult problems. The technical troops can therefore only be efficient when they take into the field the greatest possible number of their peace establishment.

(*b*). The diversity and difficulty of their duties and their trades in civil life have a much greater influence on the efficiency of the technical troops than is the case in other arms of the service. The permanency of the corps of officers, liberal provision of and a higher status for N.C.O.s, and

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a common-sense distribution of recruits, are demands which are continually recurring, urgent and justifiable.

(*c*). The increase and growth of the technical organisation must take place at the same time as that of the remainder of the army.

The writer points out that the scope and diversity of technical problems has increased from campaign to campaign, and that an increase of technical demands is to be reckoned with in the future. In peace time this is not noticeable. No matter how much in accordance with service conditions the manœuvres and exercises of large bodies of mixed arms are conceived, the corresponding employment of technical troops is most difficult and is usually very much on peace lines. But the demands on technical troops in war time are ever so much greater. This was shewn in the last South African campaign and in China. The British War Commission laid particular stress on the fact that in the later periods of the campaign the strength of technical troops was absolutely inadequate.

(*d*). The peace training of technical troops is indicated by their employment in war time. The latter must be technical. It should, however, be remembered that a purely military training and education should form the basis of all technical training in peace time; this applies to the whole of the technical troops, but more especially to the pioneers.

It is of course self-evident that purely infantry training must not be carried on at the expense of technical efficiency. Under normal conditions even superficially trained technical troops will appear efficient; but this is no guarantee that they will be the same under circumstances of difficulty and danger. In the technical service there are a large number of "tricks of the trade" which have to be drilled into the men, just like fire discipline in the Artillery and handling of rifles in the Infantry.

In a second article the writer deals with the development of the various technical questions in peace time. He points out the great responsibility of the War Office in keeping pace with the times by introducing new inventions and organising, in some cases, new branches of technical troops. He then describes how these matters are disposed of.

Engineer questions are dealt with by an Engineer Committee, subdivided into three divisions for Pioneer, Fortress and Electrical details. There are also various Experimental Detachments for Railways, Telegraphs, Balloons and Mechanical Traction. This Committee is subordinate to the Inspector-General of Engineers. The Ordnance Department assists with practical experiments.

The writer draws attention to the valuable assistance rendered by private firms, whose co-operation is ensured by the employment of officers not on the active list in their various departments. He deplores the absence of a permanent *personnel* of officers for special branches, the many changes due to retirements and transfers, and the friction which prevents harmonious working.

Year VII.—No. 8.

The following articles are of interest:—

I. A description of the BALLOON invented by General Meusnier of the French Army.

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II. An article on MORE PIONEERS, which is a criticism on a previous article entitled Our Pioneers. The writer advocates:—

1. An increase of technical troops.

2. The formation of the Pioneers into one regiment (of two battalions of four companies each) per Army Corps. Each battalion to be organised into one company of pontoniers and three of pioneers. This, he contends, is the best organisation for peace time. The pontonier companies are to be trained in bridging only, and the other companies in all technical duties. In war time one company of pontoniers and one company of pioneers is to be allotted to each Division of an Army Corps, the remaining four companies being used as a reserve for those taking the field and for siege operations.

3. The establishment of a general inspection branch of pioneers. He makes a point of the Inspector-General being as independent as possible and solely responsible for his particular branch.

III. An interesting description is given of EXPERIMENTS IN TELEPHONING by transmitting with a microphone in circuit with the carbons of a search-light and receiving with a reflector, selenium cell and telephone receiver. The writer claims to have successfully telephoned over a distance of 7 miles.

G. B. ROBERTS.

KRIEGSTECHNISCHE ZEITSCHRIFT.

Year VII.—No. 9.

THE ADVANTAGES OF THE MACHINE GUN IN THE FIGHT OF ALL ARMS.—It is difficult to answer the question what value the machine gun will have in future tactics.

The circumstances under which this weapon has appeared in war have varied with the theatre and the opponents. There is no doubt about its value for small wars, but this is no criterion for the part it may play in wars for which the armies of the Continent are training.

For the War of Masses we infer, from the fact of the Russians having immediately replaced the guns they lost at the Yalu, that the Japanese are not far wrong in valuing machine guns for the purposes of the campaign now being fought out.

Taking the arms as they are at present and the existing regulations for their use, we recognize two ranges, viz., 600 m., where aimed fire with the rifle becomes effective, and 1,400 m., where the Artillery range begins. Between these two lies a zone which is open equally to Infantry and Artillery fire, but which we regard as exceptional. Could not we hand this zone over to the machine gun?

We admit that musketry can be very effective over 600 m. We have only to turn to the Russo-Turkish War of 1877–78 and the recent campaign for instances. Artillery also can give a good account of itself at ranges under 1,400 m. But both infantry and artillery would gladly surrender the intervening zone above mentioned to the machine gun.

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Cavalry also has something to say in the matter, and so the question presents itself under three complexions, viewed from the standpoint of each arm.

Beginning with Infantry. To produce the requisite effect, fire at ranges above 600 m. should be collective and demands the combined effort of a large number of shooters; and to hold them in control the use of volleys by word of command in close order is requisite. The teaching of the Boer War rejects this proposal; for the English found themselves constrained to abandon their beloved volley firing. Independent fire at long ranges is difficult to carry out when it involves the use of several sights. No doubt peace experiments give admirable results, but in the field these are apt to be disappointing. Nevertheless Infantry must have recourse to long-range fire when the Artillery on its side has not sufficient superiority over its opponent to spare guns to support the Infantry.

Artillery support is always an unknown quantity. One ought to be grateful to have it at the decisive point in the objective. But everywhere else along the firing line the Infantry will have to resort to long-range fire to supplement the deficiencies of the Artillery, and there the disadvantages of this sort of fire become manifest. These are premature squandering of ammunition and careless, badly-aimed fire. An old war experience, revived by the Boer War, says it is only by abstention from long-range fire that the shooter can be brought to aim at short ranges with that steadiness and determination, not to be shaken by the sense of danger, that makes him will to hit with every round.

A prudent Infantry leader will use long-range fire as seldom as possible, because the soldier, by careless aiming at long ranges, very soon loses the habit of accuracy which has been drilled into him with so much care. All the same, Infantry must occasionally profit by the long range of their weapons; otherwise many a fleeting chance of success would be thrown away; for instance, Artillery limbered up moving into position.

In 1870 Prussian batteries stood out for hours together under infantry fire. In the future their staying power, even without shields, will be greater. The gunners kneel down and throw themselves flat on the ground in the intervals of fire; fewer numbers are required to work the guns, so that there will always be spare men to dig shelters for themselves.

When Artillery send forward their scouts and staff officers to select positions, are these people to remain unmolested and so be given a free hand to develop a formidable line of batteries at their leisure? Supposing the range to be somewhere about 2,000 m., or under. Well, there are few Infantry officers who would turn on whole companies to fire long-range volleys at a few mounted men. For such purposes the machine gun would prove handy.

Somebody has suggested that ere long Infantry will restrict itself to fire at medium and close ranges, the rest being done by machine guns attached to companies. (Experts say that by improvements in powder and reduction of calibre to 5 m.m. the fixed sight range can be increased to 1,000 m.). Magazine fire at long range is out of the question by the condition that the shooter must only deliver aimed fire.

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For effective long-range fire a large number of shooters is requisite to fulfil the conditions of depth, breadth and density of swarm of bullets. Also this stream must be capable of concentration at a given point at a given time. Now, as a fact, not enough men are ever available under one command to carry this out, and so the task is attempted by too few men, who are obliged to fire as quickly as they can. This degenerates into a sort of long-range magazine fire—demoralizing for the shooter. If, therefore, the Infantry can have a long-range shooting machine firing the rifle cartridge, let it be used for this purpose; and let the shooter be spared for really effective short-range fire—which is the decisive element in battles. Another argument in favour of the machine gun is its value to sweep roads, bridges, etc., much better than riflemen.

The abandonment of long-range fire would simplify the musketry instruction of the soldier, but this can only be done when every company at least has one machine gun of its own.

For Cavalry the value of the machine gun is generally recognized, while its use for Infantry is hotly debated on all sides.

In 1870 the Cavalry was not sufficiently trained for the dismounted fight; some, even, had no carbines. Since the campaign criticism has demanded independence from Infantry support for the Cavalry. Recent improvements in small arms would have put the Cavalry in a worse plight than before had they not adopted the precedent of America and followed the precepts of General von Schmidt, who, in his well-known treatise, lays down the dismounted combat as essential. This has not been accepted with enthusiasm by the Cavalry, who see in these endeavours a danger of their degenerating into mounted infantry. This in spite of the Boer War. The Cavalries of the Continent seek to foster their knightly character, which has endowed them with a glorious tradition.

This school of thinkers should greet the machine gun with acclamation. These can bear the burden of the Cavalry fire-fight; and so relieve them from the worry and confusion of telling off horse-holders in order to develop a fire power ridiculously disproportionate to the number of men engaged. (In Denmark the Cavalry have a galloping mitrailleuse which is a sort of heavy automatic repeating rifle).

Switzerland is the first to adopt mounted machine-gun detachments. Here, where mountain warfare preponderates, the machine gun takes the place of the mountain gun when a weapon of low trajectory appears requisite.

The scope of the machine gun in the Swiss Army, where it must be adapted to the nature of the country, differs from that assigned to it by the armies of the Great Powers; the latter propose for it another *rôle* besides that of entering into the decision of the fight generally and supplementing dismounted fire of Cavalry, and this *rôle* is supporting the fighting capacity of the Cavalry in the mounted combat itself.

The mounted man has suffered in his influence both by improvement of the small arm and of the field gun. It is a question whether the Cavalry cannot reinstate the important *rôle* it seeks by using machine guns to prepare its way to attack.

Infantry can defend itself, even when in small bodies, against lance and

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sabre. But if Cavalry brings up machine guns it has a strong ally against Infantry. It is not safe for Cavalry to count on the preparation of its attack by Horse Artillery. Even in manœuvres it is only by introducing unrealistic delays that the H.A. preparation can be simulated. Quick-firing guns will not alter this.

For Cavalry purposes the machine gun is best mounted on a two-wheeled carriage, with shield in position. Harnessed to this is a pair of horses, which are not taken away when the piece is fired. Plenty of ammunition should be at hand. This can be carried in light carts capable of going across country. The Swiss use pack horses.

The machine guns could often be used to support the Horse Artillery in position, and so save detaching escorts.

So long as the Artillery saw in the machine gun an inconvenient supplementary gun of a special nature, which complicated its own proper business, it extended little sympathy to its introduction. When again the authorities started special detachments it began to see a rival which would absorb a vast deal of the money otherwise to be devoted to renewing and perfecting the Field Artillery *matériel*, without which it could not hope, in the face of recent developments in small arms, to retain the pre-eminent position it had won for itself in 1870. Field Artillery must for ever strive to compete with its task of shooting at long ranges, destruction of material obstacles, firing on an objective under cover.

To admit of short-range Artillery fire being dropped the grouping of the various descriptions of pieces must be altered.

Flat trajectory guns will predominate. A few large calibre guns will be told off for special work. But with the introduction of machine guns in quantities the zone between 800 m. and 1,600 m. can be taken over by them.

Up till now Infantry has been able to render a good account of hostile Artillery up to 1,400 m., and to defend itself against Infantry attack. Its powers will be much increased by the use of machine guns.

The Field Artillery will be relieved of the responsibility for the zone under 1,400 m. It will therefore no longer be restricted to shrapnel, but may allow itself some high explosive common shell with double action fuze for use against the shields of hostile Artillery. Or, perhaps, even a general service projectile like the Maxim-Nordenfelt may prove worthy of adoption. Moreover, with this protection Artillery can be independent of Infantry escort.

When both sides are acting on the offensive it often happens that Artillery must come prematurely into action before its Infantry has pushed on sufficiently far. The protection of the guns then falls to the Cavalry, whose dismounted fire is both feeble and unpopular. So here the machine gun comes in again to keep the hostile sharpshooters in subjection, and so saves the Artillery from giving the show away by disclosing the whole extent of its position.

The whole question requires to be thought out fairly. While in its experimental stage a machine gun has been evolved, to be suitable for the double purpose of being attached either to Infantry or Cavalry. This, like all compromises, is unsatisfactory.

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For Infantry horse traction under fire is unnecessary. Better carry the gun in a good spring wagon, and when the fighting begins take it out and man-handle it.

For Cavalry, if you confine yourself to supplementing the dismounted fight only, pack transport seems the best (Switzerland, Denmark), and then you can use it in hilly country. But if it be decided to use it to prepare the Cavalry attack, then the English method of the galloping carriage is undoubtedly the best.

Various Uses of Machine Guns.

In Colonial wars we have plenty of examples of their extraordinary value.

Flying columns, cyclists, automobile detachments.

Defence of posts on lines of communication.

Defence of railways.

Suppression of insurgents or control of towns in a hostile country; small bodies of troops would then suffice if provided with these weapons.

In mountain warfare, says General Rohne, the machine gun cannot replace the Q.F. mountain gun, but it can very well supplement it, especially in holding ravines, etc. Mountain guns, the Japanese ones for instance, are of the nature of howitzers capable of fairly low trajectory. Machine guns can supply the low trajectory fire and make up for the deficiencies of the mountain gun, especially against a moving objective.

To accompany convoys. The machine guns can be distributed over the wagons and so save men.

Strangely enough, in the Boer War the English do not appear to have armed their railway blockhouses with machine guns. The machine guns on locomotives or trollies proved themselves of value.

In fortress warfare machine guns will be used on both sides with effect. The attacker will use them at long range against working parties, and at any rate hinder civilians from being employed on fortifications.

The investment can be effected with smaller numbers, and reserves to meet a sortie can be concentrated in greater numbers, because the approaches will be held by machine guns. Indirect fire, high-angle fire and night firing with the aid of search lights can be carried out. Even wire entanglements can be mown down by machine-gun fire, which can cut the stakes.

THE QUESTION OF DISTRIBUTION AND USE OF THE MACHINE GUN.—By Lieut.-Colonel von Layritz.—This officer produces a few examples from the war in progress to support his arguments. There is no need to go into them in detail, for he arrives at the same conclusions as given in the *précis* of the previous article on this subject. He explains that the English system of distribution may be well adapted to a recruited army, but is unsuited to a conscript army like that of Russia, with so short a service. He considers the German mounting with sledge carriage superior to the English. Machine guns, he thinks, should always be kept in pairs at least, so that one may cover the other in case of a "stick." Those interested in the subject would do well to read both articles *in extenso*.

J. A. FERRIER.

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NEUE MILITÄRISCHE BLÄTTER.

January—February, 1905.

(1). Some new features distinguish the issues of the *Militärische Blätter* of this year; a summary of the military events of the week is given, which those who have not much time for reading will find convenient. In the numbers of this year, so far, the war in the East occupies the principal part, but events nearer home are not forgotten. Students preparing for examinations, and those interested in their profession and desirous of improving their military judgment, will welcome the tactical problems—with solutions in separate numbers—that are proposed from time to time. These problems and solutions are contributed by well-known tactical authorities, and students are recommended to carefully compare their own written solutions with those furnished by the *Militärische Blätter*.

(2). LESSONS FROM THE WAR IN EAST ASIA.—General Von der Goltz, the well-known military author, writing in the *Deutschen Revue*, considers that the spell so long hanging over Asiatics is for ever broken, that in the future Japan will have many imitators, and that easily won victories over a badly armed and poorly organized Eastern Army, with all their demoralizing effects, is a thing of the past. He welcomes the change as likely to keep Europe better up to the mark. He considers that Japanese strategy was sound in diverting large forces for the capture of Port Arthur, and sees in this success a guarantee for the final triumph of the Japanese. He deplores the antiquated form that the war has taken—a war of positions—ascribes it to the influence of the Military Engineer, and finds in it an additional reason for the long talked of reorganization of the German Engineer. He attributes the severe losses of the Japanese at Port Arthur to be greatly due to overrating the effects of their artillery fire and therefore making premature assaults. Another article on the same subject ascribes Japanese success (1) to the permanence of their organization, there being no improvisation during the war, while the Russian Corps d'Armée are in many cases drawn from sources that were not in touch before it began; (2) to their numerical superiority at the decisive points; (3) to their better tactical training. (The author, writing before Mukden, thinks that the strategy of both armies has been bad; that of the Russians because they did not make their arrangements early, so as to be able to take the offensive with superior numbers, and the Japanese because, in spite of their victories, none of them were decisive); (4) to the baneful influence of the Council at St. Petersburg, the want of harmony between the higher leaders, etc., etc.

(3). THE SWISS ARTILLERY.—As is well known, after long and exhaustive trials the Swiss authorities adopted in preference to many others the Krupp model for a quick-firing field gun. A Government decree lately issued lays down that each battery is to consist of 4 guns and 10 munition, 1 forage, 1 pack and 2 provision wagons; 4 to 5 officers, 1 veterinary surgeon, 139 N.C.O.s and men, 21 riding and 106 draught horses. The 10 wagons carry a supply of 1,120 shell, or 280 for each gun, while the

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ammunition columns carry a further supply of 2,080 shells for each battery; thus each gun in action will have a supply of 800 shells. The 1st and 2nd Army Corps are to be provided with their guns this year, the 3rd and 4th next year. To each Army Corps 3 regiments of artillery are attached, 1 to each division, and 1 as corps artillery. Each regiment of artillery has 12 batteries or 48 guns.

(4). THE NEW FRENCH INFANTRY REGULATIONS are remarkable for their conciseness, being contained in a small volume of 106 pages; all mere parade movements are abolished and only such as are applicable in the field are retained; the latter are naturally of the simplest nature and are to be rigidly adhered to, the movements of the Company, Battalion, Regiment, etc., being made as similar as circumstances will allow. The importance of Study, Initiative and Resolution in all grades is strongly insisted on, and officers are reminded that their professional knowledge is not to be limited by what is contained in Drill Books and Regulations, but that they are expected to have a sound knowledge of Military History. Great stress is laid on the importance of individual training, this including moral, intellectual and physical as well as technical.

The Section is the ordinary unit of the firing line, but smaller units may be used according to circumstances of ground, opposition of enemy, etc. Based on the increased efficiency of musketry and artillery fire, attention is drawn to (1) the difficulty of obtaining reliable information, which can only be done by the troops under circumstances involving increased loss of life and time, for which they must be prepared; (2) that in consequence of the losses to which attacking troops are exposed, only such forms of attack are to be used as can be thoroughly adapted to the ground, in order to derive the greatest amount of protection from it, while at the same time retaining the necessary amount of mobility and striking power; under these circumstances the use of continuous lines of skirmishers is condemned, and in its place groups of the strength of sections or half sections and even in cases individual men will push forward independently for some previously designated feature of the ground, under cover of which, joined by the supports, all will assemble and dash forward for the final phase of the assault; (3) that in consequence of the great expenditure of ammunition under existing regulations, and the difficulty, if not impossibility, of replacing it, short, sudden outbursts of fire, designated *rafales*, are strongly recommended, thus assimilating infantry fire tactics to those adopted by the artillery. Troops for the attack are divided into three lines—(1) The firing line, composed of sections, half-sections, groups or individuals, according to ground, enemy's fire, etc., acting independently, but all pushing on for the designated goal, under cover of which the final preparations for the assault are made, followed up by the necessary supports; (2) the manœuvring troops; and (3) the reserve troops. The superiority of the attack over the defence is insisted on over and over again, as also the peculiar excellence of French troops in this form of the combat, although it is recognised that the defensive may have to be resorted to; this being the case, an offensive defence should as far as possible be adopted, and for this purpose

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continuous lines are to be avoided and the defending troops grouped in supporting points, the intervals being observed and troops held in readiness to act offensively through them at the right moment. The occupation of detached positions is also recommended, in spite of the many disadvantages which German authors more particularly point out.

R. A. LIVESAY.

RAILROAD GAZETTE.

February 24, 1905.

BLOCK SIGNALLING ON LINES OF LIGHT TRAFFIC (CHESAPEAKE AND OHIO RAILWAY).—When there is no money to build a second track or to provide a proper system of signalling (and the author evidently thinks auto-signalling the ideal), it is obvious that all that can be done is to devise the best method practicable for attaining safety with the appliances available. The section discussed is that from Richmond to Gordonsville—names that will be familiar to students of *Stonewall Jackson.*

The principles adopted are :—

(1). The absolute blocking of all trains against others running in the same direction, except in emergencies (*i.e.*, a space interval).

(2). The blocking of all trains against others running in the opposing direction, subject to (*a*) a station limit rule, (*b*) special cases, when special Orders are given by the Despatcher—a separate Order in each case.

The meaning of these exceptions is:—(*a*) Stations are provided with a two-armed signal only, and, when a train is to cross another at the Station, the first is allowed to draw about half-way past the signal, while, by Standing Order, trains approaching from the opposing direction must enter the loop. (*b*) In the case of trains meeting at intermediate sidings, the meeting point is definitely fixed by the Despatcher by Order, and the train men are not given any latitude to alter the meeting place in pursuance of their Rights.

The system is, in fact, an improvement on the ordinary one of Time-table running, where all security is provided by time interval, and safety depends in a great measure on protection by flagging or detonators in case of delays. A sample Timetable is printed, in which we observe that, at scheduled meeting points, the trains to be passed or crossed are indicated by their numbers in small type. As remarked elsewhere, this practice does not seem to be common.

C. E. VICKERS.

REVUE D'HISTOIRE.

March, 1905.

THE CAMPAIGNS OF MARSHAL SAXE.—The description of the battle of Fontenoy is continued, but not finished. In dealing with the incident of Lord Charles Hay, the writer follows the accepted French version :—"A vous, messieurs les Français, à tirer." Hay's own account, as quoted

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by Carlyle in his life of Frederick, is as follows:—"When we came within twenty or thirty paces of them (the French Guards), I advanced before our regiment, drank to them, and told them that we were the English Guards, and hoped that they would stand till we came quite up to them, and not swim the Scheldt as they did the Mayn at Dettingen."

THE CAMPAIGN OF 1794.—*The Army of the North.*—The plans of operations drawn up by the French and by the Allies are followed in great detail through their several stages, and are afterwards discussed with reference to the criticisms made upon them by Jomini, the Archduke Charles, Napoleon, and others. "The French plan is essentially the conception of military engineers; Carnot, D'Arçon, Lafitte-Clavé, de Rivière are mainly engineers who have drawn their ideas from the memoirs of the Eighteenth Century on the advantages of frontier fortresses and the combinations to which they lend themselves." At the same time the writer shows how much the Allies were handicapped by the demolition of the Belgian barrier-fortresses by Joseph II. a few years before.

In the second volume of Lord Grenville's papers (Fortescue MSS.), published in 1896, there was a series of remarkable bulletins, which purported to come from Ramon, the Secretary of the Committee of Public Safety, revealing the proceedings of that Committee. M. Aulard, a very high authority, pronounced them to be unworthy of attention; but the writer of this history accepts them as good evidence, and quotes freely from them.

SIDI-BRAHIM.—This chapter discusses the responsibility of the various persons concerned in this disaster.

E. M. LLOYD.

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RECENT PUBLICATIONS.

Supplement to Field Service Regulations. Engineers:—Railway Company of Sappers and Miners and Field Telegraph Section. Provisional. (Official. 8vo. pamphlet. Calcutta).

Memoranda relating to the Organization, Equipment, Instruction, etc., of Engineer and Signal Corps Troops. (Official. 8vo. pamphlet. Washington).

Manual for Operation and Care of Colt Acetylene Flash Lantern. (Official. 12mo. pamphlet. New York).

Militär-Schulen, 1905. (Official. 4to. Berne).

Deutschlands Nächster Krieg, by Oberstleut. Osten-Sacken-Rhein. (4to. Berlin).

Unsere Pionere: Eine historische und organisatorische Studie für Offiziere aller Waffen, by Oberst C. Schweninger. (8vo. pamphlet. Berlin).

Exerzier-Reglement für den Train vom 8 *Dezember*, 1904. *Entwurf.* (Official. 12mo. Berlin).

Instruction provisoire sur le service de l'artillerie dans la guerre de siège. (Official. 8vo. pamphlet. Paris).

Military Government and Martial Law, by W. E. Birkhimer, LL.B., Major, General Staff, U.S. Army. (3 dols. Kegan Paul, Trench, Trubner & Co.).

Military Studies (No. 8 of the International Military Series), by F. L. Huidekoper. (Hudson-Kimberley Publishing Co., Kansas, Mo.).

Problems in Manœuvre Tactics (with Solutions for Officers of all Arms), by Major J. H. V. Crowe, *p.s.c.*, R.A., after the German of Major Hoppenstedt. ($8\frac{1}{2} \times 5$. 6s. Smith, Elder).

Principles of Strategy, by Capt. E. Nash, late R.A. (3s. 6d. Kegan Paul).

The Evolution of Modern Strategy from the 18th Century to the Present Time, by Lieut.-Colonel F. N. Maude, *p.s.c.*, late R.E. (9×6. 5s. W. Clowes & Sons).

The Fight with France for North America, by A. G. Bradley. ($8\frac{1}{2} \times 5\frac{3}{4}$. 3s. 6d. Constable).

The War of the Succession in Spain during the Reign of Queen Anne, 1702—1711, by the Hon. A. Parnell. New edition. (7s. 6d. Bell).

One Hundred Years Ago. Battles by Land and Sea: Ulm, Trafalgar, Austerlitz, by Colonel G. A. Furse, C.B. (9×6. 10s. W. Clowes & Sons).

The Conquest of the South West; the Story of a Great Spoilation, by C. T. Brady, LL.D. (8vo. New York).

The Truth about Tibet, by A. Maccallum Scott. (Simpkin, Marshall & Co.).

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Die Festung in den Kriegen Napoleons und der Neuzeit. (Band 4. Studien der Kriegsgeschichte und Taktih) herausgegeben vom Grossen Generalstabe, with separate volume of plans. (10×6½. Mittler & Sohn, Berlin).

Krieg gegen die Französische Revolution, 1792—1797. Band 1 & 2. (Kriegsgeschichtliche Abteilung, Kriegsarchiv). (Official. Vienna).

Im Hauptquartier der Russischen Armee in Polen, 1863—1865; *persönliche Erinnerungen*, by J. v. Verdy du Vernois. (8vo. Berlin).

Zur Kriegzeit auf der sibirischen Bahn und durch Russland, by Haupt. Karl Tanera. (8vo. Berlin).

La guerre Russo-Japonaise; résumé historique et chronologique des evénements. Tome I. Du début des hostilités, 8 Fév., 1904, au 4 Juillet, 1904, par L. Thiriaux. (8vo. Namur).

La guerre de 1870–71. *Les Opérations autour de Metz:* 3. *Journées des* 17 *et* 18 *Août.* 3 vols. (Official. 8vo. Paris).

Essai sur la défense des Colonies, par Capt. Ferradini. (8vo. pamphlet. Paris).

Military and Naval Dictionary, compiled by Major J. P. Wisser, U.S. Army, and H. C. Gauss, Esq., of the Navy Department. (½ dol. L. R. Hamersly Co., New York).

A French-English Military Vocabulary, compiled by Capt. H. T. Russell, R.F.A. (7¼ × 4¾. 1s. 6d. Clowes).

Astronomers of the Day and their Work, by Hector Macpherson. (8¼ × 5½. 7s. 6d. Gall & Inglis).

Extracts from Narrative Reports of the Survey of India, 1902–03. (Official. Folio. Calcutta).

A Handbook for Superintendents of Construction, Architects, Builders, and Building Inspectors, by H. G. Richey. (17s. Chapman & Hall).

Steam Turbines (with an Appendix on Gas Turbines and the Future of Heat Engines), by Dr. A. Stodola, Professor at the Zurich Polytecknikum, translated by Dr. L. C. Lowenstein, Lehigh University. (9¼ × 6. 21s. Constable).

Self-propelled Vehicles. A Practical Treatise on the Theory, Construction, Operation, Care and Management of all forms of Automobiles, by J. E. Homans. 2nd edition. (8vo. New York).

Imperialism: Its Prices and Vocation, by Emil Reich. (7½ × 5. 3s. 6d. Hutchinson).

Modern Constitutions in Outline. An Introductory Study in Political Science, by Leonard Alston. (8vo. pamphlet. London).

The Friends of England, by Hon. George Peel. (12s. Murray).

Studies in General Physiology, by Jacques Loeb, Professor at California University. 2 vols. (9×6. 31s. 6d. Unwin).

The United States of America. Part I., 1783—1830, Part II., 1830—1900, by E. E. Sparks, Ph.D. (8vo. London).

The Early History of India from 600 *B.C. to the Muhamadan Conquest, including the Invasion of Alexander the Great*, by Vincent A. Smith, M.R.A.S. (14s. Clarendon Press, Oxford).

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The Story of an Indian Upland, by F. B. Bradley-Birt. (9 × 5¾. 12s. 6d. Smith, Elder).

The Sun and the Serpent, by Brig.-Surg. C. F. Oldham. (10s. 6d. Constable).

Jats, Gujars and Ahirs (Handbooks of the Indian Army), by Major A. H. Bingley. (Official. 8vo. Calcutta).

Mappillas or Moplahs (Handbooks of the Indian Army), by Major P. Holland-Pryor. (Official. 8vo. Calcutta).

Imperial Japan: The Country and Its People, by G. W. Knox. (8¾ × 5½. 7s. 6d. Newnes).

Japan: An Attempt at Interpretation, by L. Hearn. (8vo. New York).

A Register of National Biography, with a Selection of the Chief Bibliographical Books and Articles published in other Countries, by W. P. Courtney. 2 vols. (8½ × 5½. 31s. 6d. Constable).

Author and Printer. A Guide for Authors, Editors, Printers, Correctors of the Press, Compositors and Typists, by F. H. Collins. (7½ × 5. 5s. Frowde).

Manual of Practical Indexing, by A. L. Clarke. (8vo. London).

English-Japanese Dictionary of the Spoken Language, by Sir E. M. Satow, G.C.M.G., and Ishibashi Masakata. 3rd edition, revised by E. M. Hobart-Hampden and H. G. Parlett. (8vo. Yokohama).

German Technical Words and Phrases. An English-German and German-English Dictionary of Technical and Business Terms, by C. A. Thimm and W. v. Knoblauch. (12mo. London).

An Angler's Hours, by H. T. Sheringham (Angling Editor of *The Field*). (8 × 5. 6s. Macmillan).

The Effects of Tropical Light on White Men, by Major C. E. Woodruffe, Surgeon, U.S. Army. (Rebman).

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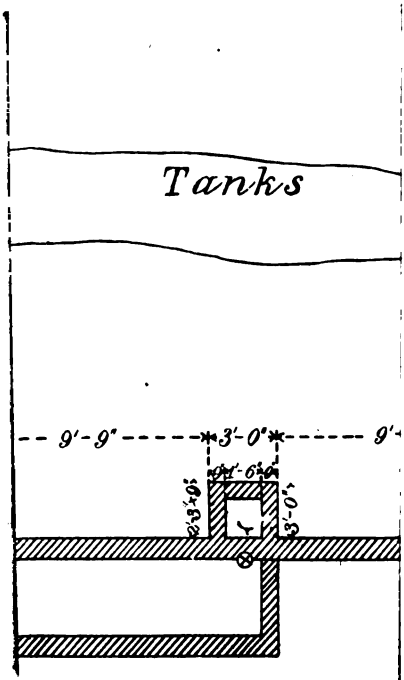

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Militia Literary: G. V. C. Irwin, A. St. J. Wright, M. C. Coote, R. Lechmere.

Woolwich (Dec., 1904): 2nd, F. W. Thicknesse; 7th, O. E. Fane; 24th, C. O'Driscoll Preston. (Two others previously).

Sandhurst (Dec., 1904): 24th, G. de la Poer Beresford; 32nd, H. G. C. Colville; 68th, C. H. Blackburn. (Two others previously).

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The main object of the Army School is the preparation of boys from the age of twelve years for Woolwich and Sandhurst—just as pupils are prepared at the Royal Naval College, Osborne, for the Royal Navy. Boys are placed in one of the Army Classes (limited to eight boys in number) the moment they enter the School, whereas at many of our Public Schools they often waste two or three years before they are considered eligible for the Army Class. At the Army School all the advantages of Public School Life—college, chapel, games, gymnastics, drill, *esprit de corps*—are combined with individual tuition and attention; while the disadvantages of large class teaching is done away with owing to the fact that the proportion of masters to pupils is always six to one.

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SUCCESSES, 1902—4.

G. C. SLACKE. Sandhurst. Infantry. 8595 marks. First Trial. Indian Staff Corps. FIRST in Latin. THIRD in Greek. TWELFTH in Essay and Précis (after one year's preparation at the Army School, formerly of Rugby School).
H. MULLALY. Sandhurst. Infantry. 7188. 2nd Trial. Increase of 1939 in two terms.
E. R. SCHREIBER. Sandhurst. West India Regt. (refused). 6397. First Trial from the Army School. Increase of over 1700 (after one term's preparation, formerly of Radley College).
R. W. MANDERSON. Sandhurst. Indian Cadet. 5694 marks. 2nd Trial. Increase of 2049 in two terms.
J. WATSON. Woolwich. 10089 marks. 2nd Trial. Increase of 1795 in two terms. FIRST in Freehand Drawing. SEVENTH in Physics.
C. MULLALY. Sandhurst. 7514 marks. First Trial.
A. BROKENSHAW, R.I.E.C., Cooper's Hill.
E. B. TOD, Royal Navy, "Britannia." THIRD in Latin.
G. SARTORIUS. Sandhurst. King's Indian Cadet. First Trial. (Formerly of Charterhouse School).
J. W. D. NOBLE. Sandhurst. King's Indian Cadet. First Trial. (Formerly of Bradfield College).

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J. B. C. TREGARTHEN. Passed out of Woolwich. R.G.A. Specially mentioned in Mathematics.
G. T. SAVAGE. Passed out of Sandhurst. Gazetted to A.S.C.
G. C. SLACKE Passed out of Sandhurst. Corporal, Rugby XV. Indian Army.
H. MULLALY. Passed out of Sandhurst. First Prize in Gymnastics. Indian Army.
J. WATSON. Passed out of Woolwich. Obtaining Royal Engineers. Corporal.
C. MULLALY. Passed out of Sandhurst. Corporal, Rugby XV. Indian Army.

N.B.—Special attention is drawn to the following facts, as evidenced by the above statistics:—

(*a*). The education at Trinity College is such that the pupils, when they *have* passed in, are not worn out or rendered limp by the effects of cramming; but nearly one and all show at Woolwich or Sandhurst a continued all-round proficiency.

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GLAREANUS.

By MAJOR C. F. CLOSE, C.M.G., R.E.

THE *De Geographia Liber* of Glareanus, printed in Basle in 1527, is well known to those interested in geographical studies. But it is only recently that the original manuscript has been discovered. This manuscript is bound up with other sixteenth-century and seventeenth-century manuscripts in a volume which is now in the possession of Major-General E. Renouard James (late R.E.). The ownership of the volume can be traced back to Jean Henri Ott (1617—1682), Major-General James's direct ancestor.

Heinrich Loriti, called Glareanus from his birthplace in the Canton of Glarus, was born in 1488 and died at Freyburg in 1563. He was "one of the early promoters of physical science, a scholar and a man of very varied learning." He was a friend of Erasmus, and the volume contains a letter, dated 1516, written to him by Erasmus. We get a glimpse of their friendship in Froude's *Life and Letters of Erasmus:* "His (Paul III.'s) first act on his accession had been to make advances to Henry VIII. . . . He sent the Cardinal of St. Angelo to Germany to feel his way towards a reconciliation. In Clement's time Erasmus had been denounced, as he complained, in every church and at every dinner. The Cardinal of St. Angelo now sent him profuse compliments along with a handsome present." 'The Cardinal (wrote Erasmus at Freyburg, 9th January, 1535) has given me a magnificent gold cup as a sign of his good will. I produced it for my friends Glareanus and Rhenanus, who were dining with me.'

Mr. E. Heawood has shown that the manuscript was probably written about the year 1510, seventeen years before the book was printed at Basle.

It will be interesting to note the state of cosmographical knowledge in the year that the treatise was written. Columbus had discovered the new world eighteen years before, and the spherical shape of the earth was an accepted fact; but the conception of the universe as a whole was still very primitive. Glareanus gives a diagram in which the earth occupies the centre; the sun and planets revolve round the earth after the elements of Air, Fire and Water; there is then the 9th Heaven, the Aqueous or Crystalline Sphere; the 10th Heaven, the "primum mobile"; the fixed stars; and the Cerulean Sphere, or abode of the Souls of the Blessed Departed, outside of all. In the

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description of this planetary system occurs the quaint phrase, "the spheres slide loosely over each other like the skins of an onion."

Copernicus was at this time working at the planetary motions, but his book *De Orbium Cœlestium Revolutionibus* was not published till 1543. Until this date the onion theory held the field, and indeed it did not finally vanish from certain conservative institutions for nearly three centuries.

The treatise consists of forty-five pages of paper, about the size of a sheet of foolscap, written on both sides. The work is entirely in Latin and the writing is beautifully clear. There are numerous illustrations in the body of the text and seven full-page maps in colours; a reproduction of one of these, the map of the Northern Hemisphere, forms the frontispiece of this number of the *R.E. Journal.* Great care has been taken to make the reproduction as exact as possible, but the aged appearance of the paper, resulting from the passage of four centuries, has not been imitated; the reproduction must closely represent the appearance of the original as it came fresh from the old geographer's hands.

The principal headings of the chapters into which the book is divided are: De Geometriæ Principiis; De Partibus Essentialibus Totius Universi (illustrated by a diagram of the celestial spheres arranged on the onion theory); De Motibus Corporum; Quid Sphæra, Axis, Poli, et Polorū Nomina; Quid per Elevationem Poli Intelligatur; De Parallelis; De Climatum Ratione; De Latitudine; De Longitudine; De Ventis; De Pictura Globi; De Inducenda Bapyro in Globo; De Divisione Terræ; De Europa; De Regionibus Quæ Libro Sunt Apud PTOLEMÆUM.

The chapter last mentioned commences with an account of Ireland:—HYBERNIA insula maxime ad occasum et septentrionem, a septentrione Hyperboreo alluitur oceano. . . . Hodie dicitur Irland. Paret hodie Anglorū regi. Homines sunt agrestes.

The description of the various countries of Europe is followed by similar accounts of Africa and Asia, and at the end of the book there are a few lines on the newly discovered land called America: "Sūt qui putent tempore Augusti Cæsaris eam terrā quoq fuisse notā." . . .

To modern readers the most interesting features of the treatise are the map projections used. There are seven full-page maps. Three of these are on a projection of which, on account of the comparative roughness of the drawing, it is difficult to discover the exact law. It is a modification of a projection used in previously published editions of Ptolemy. The parallels are circles but are not concentric; the meridians are circles and the lengths along the meridians are true.

The other projections are more important. One is a conical projection with rectified meridians; the pole is the centre of the parallels and there is one standard parallel. This projection was copied from Ruysch (1508). The result is two fan-shaped maps, stretching from

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the North Pole to 37° S., each showing 180° of longitude. The angle at the pole is 108°, and the parallel 5° S. is therefore true to scale. This is an early instance of the use of that important projection "Conical, with Rectified Meridians and Two Standard Parallels"; in this case the pole is one of the standard parallels.

The other projection is the "Equidistant Polar Projection." Glareanus shows two maps on this projection, one of the Northern Hemisphere (see *Frontispiece*) and one of the Southern. This is the first known instance of the use of the Equidistant Projection.

None of the projections used are derived from the sphere by any obvious geometrical process, and it would have been well if modern map-makers had always followed this excellent example.

The writer of this note is much indebted to Major-General Renouard James for so kindly lending the manuscript, and for permitting the reproduction of the map.

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THE BATTLE OF NANSAN.

22ND MAY TO 26TH MAY, 1904.

By BT.-COLONEL J. D. FULLERTON, R.E.

I. DESCRIPTION OF THE BATTLEFIELD.
II. THE OPPOSING FORCES AND THEIR DISPOSITIONS.
III. NARRATIVE OF EVENTS.
IV. COMMENTS.

I. DESCRIPTION OF THE BATTLEFIELD.

Extent.—Roughly speaking the battlefield is bounded on the north by the hills north of the town of Kinchau; on the east by Ta-ho-shang-shan; on the south by Talienwan Bay; and on the west by Nan-kwan-ling Hill and Kinchau Bay.

Hills.—The principal feature is the line of Nansan—Nan-kwan-ling Hills, running from the town of Kinchau in a southerly direction; these hills formed the main Russian position. About the centre they are some 300 ft. in height, but on the flanks towards Talienwan and Kinchau Bays they are much lower. Nan-kwan-ling is about 800 ft. in height, and indirect fire on the country about Yen-chia-tun was freely used from it by the Russians. Ta-ho-shang Mountain (2,000 ft.) is a very rough and rugged mass of hills, the slopes of which command the Kinchau position, and was largely used by the Japanese for Artillery positions.

The Isthmus or narrow neck of land between Kinchau and Talienwan Bays is about 1½ miles wide, very flat, and hardly above sea level. The ground generally is stony, wet and sandy, affording little or no cover for an advance against the Nansan position.

Roads.—The principal roads in the area are :—

1st. The Port Arthur—Su-kia-tun—Kinchau—Shi-san-li-tai route to Pulantien (Port Adams) and Liao-yang.

2nd. The Kinchau—Wan-chia-tun route to Pitsewo.

3rd. A route from Pitsewo to Kinchau, *viâ* the south pase of Ta-ho-shang-shan.

All these roads were of an inferior character, rough and in indifferent condition.

Railway.—The Siberian or Manchurian railway runs through the area in a south-west direction, passing a little to the east of Kinchau and thence close under the base of Nansan Hills to Ta-fang-shan

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Station (head of Talienwan Bay). At the station the line diverges, the main line going west, *viâ* base of Nan-kwan-ling Hill, to Port Arthur, while a branch runs south to Talienwan. The line was in good order and was freely used by the Russians in their retreat from Kinchau.

Towns.—Kinchau is a large Chinese city, about 700 yards long by 600 yards wide, surrounded by a wall 30 ft. high. It is of little use as a military position as it is commanded by hills on the north, east and south-east sides, within easy artillery range, and though occupied as an advanced post by the Russians, it was not seriously held.

There are a number of small villages scattered about the area, but none of them are of any importance.

The Weather.—All through the 25th May, there was a very strong wind, succeeded by heavy rain. There was a very severe storm with lightning about 2 a.m. on 26th, and the bad weather prevented the Japanese Naval detachment (in Kinchau Bay) coming into action as early as had been intended. There was a very thick fog early on the 26th May, which necessitated postponing the opening of artillery fire till 5.30 a.m., an hour after the appointed time.

II. THE OPPOSING FORCES AND THEIR DISPOSITIONS.

A. THE RUSSIAN FORCES.

(*a*). *Military.*

The Russian troops available for the defence of the Nansan position were :—

In command—General Stoessel, Commanding IV. Siberian A.C.

4th East Siberian Rifle Division (Gen. Fock)	1st Brigade (Gen. Dimitrowski)...	13th Regt. (3 battalions)
		14th Regt. (3 battalions)
	2nd Brigade (Gen. Nadjejin) ...	15th Regt. (3 battalions)
		16th Regt. (3 battalions)
4th East Siberian Rifle Artillery Brigade ...		5th Regt. (3 battalions)
		2 batteries—16 guns.

In addition to the above there were technical troops, some sailors employed in manning the heavy guns, and 5 companies of Railway Guards.

The Nansan position stretched across the isthmus, from Kinchau Bay to Talienwan Bay, Kinchau town being held as an advanced post on the left, while the batteries about Ho-shang-tao formed a support to the right of the position. Nansan Hill itself was strongly fortified, with 14 gun batteries and numerous trenches ; the front and north flank were also well defended by barbed wire entanglements, deep military pits and contact or observation mines. There were search lights at Hon-ying, Tso-ying and Yang-pao-ying.

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The gun batteries were as follows (No. 1 being at the south point of the defences, No. 8 at the north, and so on) :—

Nansan Hill.—No. 1, eight field guns 8·7 cm.; No. 2, four guns 8·7 cm.; No. 3, four guns 10·5 cm.; No. 4, one gun 15·45 cm.; No. 5, two guns 8·7 cm.; No. 6, four guns 15 cm. and 4 mortars 15 cm.; No. 7, four guns 8·7 cm.; No. 8, four field guns 8·7 cm.; No. 9, four field guns 8·7 cm. and 4 guns 8·7 cm.; No. 10, six field guns 8·7 cm. and 2 guns 8·7 cm.; No. 11, not armed; No. 12, not armed, ammunition store; No. 13, two field guns 8·7 cm.; No. 14, two guns 8·7.

Kinchau.—Two guns 7·5 cm.; two guns 8·7 cm.

Nan-kwan-ling.—Four guns 8·7 cm.

Above Ta-fang-shan.—Two guns 15 cm.; two guns 10·5 cm.

Various.—Five guns 15 cm.; two guns 12 cm.

The heavier calibre guns were chiefly guns taken from the Chinese when the Russians acquired Port Arthur.

On Nansan Hill, the batteries on the north slopes fired chiefly to the north, over Kinchau Bay; the batteries on the east slopes fired to north and east and south-east, while those on the south slopes fired south, south-east and south-west.

The fieldworks on Nansan and Nan-kwan-ling Hills were of a very ordinary type; the batteries, trenches, entanglements, pits, etc., being of designs very similar to those shown in our *Manual of Military Engineering.*

The following points are noticeable :—

1st. The trenches followed the contours of the ground; they had a low command and were blinded in parts; there were good covered communications from the batteries to the trenches.

2nd. The batteries were well revetted and well traversed; shell stores under the traverses; guns about 33 ft. from centre to centre.

3rd. The principal batteries were connected by telegraph and telephone.

4th. Wire entanglements were very largely used; nearly the whole front and north flank being protected by them; the posts were 5 ft. high.

The outpost line was approximately Shi-san-li-tai (3½ m. north-east of Kinchau)—Palichwang—Yang-pao-ying.

The total force comprised about 11,000 infantry, 2 field batteries, 500 railway guards, 1,500 sailors, technical troops, etc.; total about 13,400 men with 70 guns.

(*b*). *Naval.*

The Naval detachment was as follows :—

Gunboat *Bobr* Destroyer *Burni* „ *Boiki* 5 steam launches used as transports	In Talienwan Bay.

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B. THE JAPANESE FORCES.

(*a*). *Military.*

The Japanese Military force was as follows :—

In command—General Oku, Commanding II. Japanese Army.

I. Division. Lt.-Gen. Prince Fushimi.	1st Brigade	1st Regt.
		15th Regt.
	2nd Brigade	2nd Regt.
		3rd Regt.
III. Division. Lt.-Gen. Oshima.	5th Brigade	6th Regt.
		33rd Regt.
	17th Brigade	18th Regt.
		34th Regt.
IV. Division. Lt.-Gen. Ogawa.	7th Brigade	8th Regt.
		37th Regt.
	19th Brigade	9th Regt.
		38th Regt.

Independent Artillery Brigade (1 regiment)—Maj.-Gen. Uchiyama.

The total strength was 36 battalions, 144 guns (108 with the Divisions, and 36 with the Independent Artillery Brigade), and miscellaneous troops ; or about 45,000 men and 144 guns.

(*b*). *Naval.*

The Naval Detachment comprised :—

Gunboat *Akagi*
„ *Chokai*
„ *Tsu-kushi*
„ *Heirgen*
} In Kinchau Bay.

III.—NARRATIVE OF EVENTS.

22nd May.—The Russians held the Nansan position, their outposts having been driven in during the period 16th May to 22nd May, 1904. The Japanese were occupied in reconnoitring the position.

23rd May.—The Japanese, who had advanced by the following routes :—

IV. Division : Shih-san-li-tai—Kinchau,
I. Division : road south of Ta-ho-shang-shan—Kinchau,
III. Division : Pitsewo—Kinchau,

occupied the line Chiu-li-chwang—Chen-chia-tien—Chiu-li-tai (3 m. north north-east of Kinchau), with outposts along the base of the

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Ta-ho-shang-shan. The general results of the reconnoissances premised :—

(*a*). About 8 heavy guns on Ho-shang-tao facing Talienwan Bay; some fired north-east towards Hon-ying; calibre could not be ascertained.

(*b*). The works at Nansan Hill held guns of following calibres, 20 cm., 15 cm. short Canets, 10 cm., 8·6 cm., 7·6 cm., and some Q.F. field guns.

(*c*). Wire entanglements were in position from Yen-chia-tun round base of Nansan Hill to Kinchau.

(*d*). There was a small work on the heights of Nan-kwan-ling.

(*e*). Search lights were in position at Hon-ying, Tso-ying, and Yang-pao-ying.

The Russians on this date were well aware of the Japanese strength, and estimated their force at about 45,000.

24th May.—The general advance of the Japanese began. Further reconnoissance showed that the south defences of Nansan Hill were possibly not quite so strong as those to the east and north. Orders for the attack of the position on 25th May were issued. A naval detachment was instructed to co-operate, in Kinchau Bay.

25th May.—Owing to the bad weather the Japanese Naval detachment was unable to co-operate with the land forces, and the attack was consequently postponed. The outpost line was however pushed in further towards the Russian position, and there was a general artillery engagement between 5.30 a.m. and 9 a.m. Further reconnoissance showed that the entrenchments on Nansan were still under construction. At 6 p.m. orders for the attack were again issued.

IV. Division : to attack Kinchau, and left flank of Nansan.
I. Division : to move direct on Nansan.
III. Division : to attack right flank of Nansan.
Independent Artillery Brigade : to take up a position about 2 miles east of Nansan, on the slopes of Ta-ho-shang-shan.
Attack to take place at daybreak ; artillery to open fire at 4.30 a.m.

The Russians used their military balloons very freely this day; ten balloons were up for about 6 hours, and though constantly fired at, none of them were hit.

26th May.—12 *midnight.*—The IV. Division attacked Kinchau ; but owing to the very bad weather and the darkness, had to desist.

5.20 *a.m.*—Part of the I. Division succeeded in capturing Kinchau, blowing in the north gate. The Russian detachment, some 600 strong, suffered severely in the retreat.

5.30 *a.m.*—Owing to the thick fog it was not possible to commence the artillery bombardment at the hour ordered, but from 5.30 a.m. to 9 a.m. a heavy fire was kept up on Nansan.

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6 *a.m.*—The Japanese Naval detachment opened fire on Nansan from Kinchau Bay; owing to the rising tide the gunboats were able to push well in, and maintained a very severe fire on the left rear of the position.

9.30 *a.m.*—The Russian fire, which up to this time had been very heavy, appeared to slacken. The Japanese infantry commenced their attack, advancing all along the line by a series of rushes to within 300 to 500 yards of the entanglements; but could get no closer. The two Russian field batteries retired to Nan-kwan-ling, from which point they kept up a very heavy indirect fire on the Japanese III. Division south of Yen-chia-tun.

10 *a.m.*—The Russian gunboat *Bobr* appeared in Talienwan Bay east of Ho-shang-tao, and kept up a vigorous fire on the III. Division which suffered severely. The Russians also tried to land a party from steam launches, but the attempt failed.

11 *a.m.*—By this hour some of the Russian guns on Nansan had been silenced, but the fire from the Russian position generally was still so heavy that the infantry attack could make no progress.

2 *p.m.*—The position of the III. Division was now rather critical. It was under a heavy fire from Nansan and Nan-kwan-ling, while on the left flank the Russian gunboat *Bobr* was still in action. Some little assistance however was given to it by the fire of the Japanese gunboats *Akagi* and *Chokai*, which kept up a heavy bombardment of Nansan, and to a certain extent held the Russian batteries on North Nansan in check. The *Chokai* lost her captain, but their light draught enabled both vessels to remain in Kinchau Bay, and there is no doubt that their fire contributed considerably to the final success of the attack.

5 *p.m.*—The Officer Commanding the Artillery reported that the gun and wagon supply of ammunition was running out, and General Oku decided to make a determined infantry attack all along the line. This was done, and nine attacks were made with the greatest bravery but with little success.

7 *p.m.*—About this hour the IV. Division, assisted by the Japanese Naval detachment, managed after a severe fight in the water to gain a footing on the north of Nansan Hill; a general vigorous advance was then pushed all along the line, and by 7 p.m. the Japanese infantry occupied the whole position. The Russians retreated to Nan-san-shih-li-pao, and there was no further fighting.

The Japanese losses were :—Killed, 33 officers, 716 other ranks; wounded, 100 officers and 3,355 other ranks.

The Russians had 10 officers and 694 other ranks killed, who were buried by the Japanese on the field of battle, the total losses being about 4,000. Their losses in guns were :—heavy and field guns of different kinds 68, machine guns 10.

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IV. COMMENTS.

1. *The Russian Plan of Operations.*

The Nansan position formed the extreme east line of defence of Port Arthur, and was a natural one for the Russian Commander to take up. The general line held was, as far as land defence goes, a strong one, especially against attack by infantry; but the slopes of Ta-ho-shang-shan formed good positions for the Japanese artillery, and were a distinct disadvantage to the defenders.

The real weak points of the position were however the flanks, as these were both within easy artillery range from ships in Kinchau and Talienwan Bays. Fortunately for the Russians the gunboat *Bobr* and two destroyers held Talienwan Bay; but the final success of the Japanese was very largely due to the heavy fire kept up on the left flank of Nansan Hill by the Japanese Naval detachment; in fact it is very doubtful whether the position would have been taken if the Naval detachment had been unable to come into action.

With regard to the actual conduct of the defence, it is rather curious that the Russians did not make a vigorous counter attack, about 5 p.m. on the 26th, on the Japanese left flank round the south of Nansan Hill. The Japanese III. Division had suffered severely all through the afternoon, and it is probable that a sharp counter attack would have seriously inconvenienced the attacking forces. Possibly the want of troops was the reason for the purely defensive tactics practised by the Russians; but with the large number of troops available at Port Arthur, it seems unfortunate that an extra brigade could not have been spared for offensive operations. Probably the defenders felt so confident of holding the position that they did not think offensive tactics necessary.

2. *The Japanese Plan of Operations.*

Owing to the very limited front the Japanese Commander had little choice of ground on which to make his attack. Virtually a direct frontal attack all along the line was necessary, as the position could not be approached in any other way, at all events in the early stages of the action.

The employment of the Naval detachment in Kinchau Bay was of very great importance; and had more ships been able to take part in the attack, the battle might have been won at a very much earlier hour and at a far smaller cost. The Japanese do not seem to have been aware of the presence of the Russian Naval detachment in Talienwan Bay, or no doubt some of the Japanese ships would have been detailed to deal with it.

With regard to the question of frontal attacks against entrenched positions, there can be little doubt that, on this occasion, such attacks

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failed. The final success of the operations was due to the combined fire of the land and sea artillery, and to the magnificent flank attack of the Japanese IV. Division.

The general lesson of the action seems to be that a direct attack against an enemy well entrenched in a good position is almost certain to fail; and that success can only be attained by operating against the flanks, or against some particular weak point in the position, simultaneously with the direct attack.

3. *Reconnoissance.*

The very careful manner in which the Japanese reconnoitred the Russian position should be noted. The greatest care was taken to try and discover the positions of the guns, trenches, obstacles, etc., and at least *four days* were devoted to this work alone. The result was most successful; for when the assault really commenced on the 26th May, the Japanese Commander had very full information as to the enemy's position and was considerably assisted thereby in making his preparations for the attack.

4. *Artillery.*

The principal points to notice about the Japanese artillery are:—(1) The skilful manner in which it supported the infantry attack, and (2) the excellent combined action of the land and sea artillery forces.

The Russian artillery worked well, especially the two field batteries at Nan-kwan-ling and the Naval detachment in Talienwan Bay; but the guns on Nansan Hill appear to have been a good deal exposed, and it was probably on this account that they were unable to obtain the best results.

5. *Engineers.*

The Russian position was strongly entrenched and well provided with wire entanglements, military pits and land mines. The type of gun shelter used does not seem to have been a good one; but the obstacles were very effective, and would have been more so if the wet weather of the 25th—26th May had not caused the positions of the mines to show up so much.

The Japanese Engineers showed great skill and courage; the destruction of the gate of Kinchau Castle and the cutting of the land mine cables, both operations being conducted under heavy fire, were splendid feats of arms and highly creditable to the Japanese scientific corps.

NOTE.—The plan is reproduced from the *Voennyi Sbornik* by the kind permission of the Russian Imperial Military Authorities. As most of the places have different names in Chinese, Russian and Japanese, the names which appear to be most commonly used in the different accounts of the battle have been inserted on the plan.

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THE ANGLO-FRENCH BOUNDARY COMMISSION IN NORTHERN NIGERIA, 1902—1904.

By Bt.-Lieut.-Colonel G. S. McD. Elliot, R.E.

THE boundary between Northern Nigeria and the French possessions to the north, as defined by the Paris Convention of 1898, is shown on the map.

It started from the east bank of the Niger near Dole ; and followed the median line of a depression, called the Dallul Mauri, till this line was cut by an arc of a circle of 100 miles radius, with the city of Sokoto as centre. This arc was the boundary till, after passing the meridian of Sokoto, it cut the parallel of 14° N. This parallel was followed for 70 miles, and then the frontier turned due South till it reached the parallel of 13° 20′ N. After running 250 miles along this parallel, it turned North till it regained the 14° N., which again became the boundary till it cut a meridian 35′ East of the centre of the town of Kukawa. It finally followed this meridian down till it reached the southern shore of Lake Chad.

The British Section of the Boundary Commission* left Liverpool on the 4th October, 1902, and on the 21st reached the Forcados mouth of the Niger, where we left the ocean steamer and got on a stern-wheeler that took passengers and mails up to Lokoja. This place we reached on the 27th.

At Lokoja we heard through an officer of the French Niger Flotilla that the French section of the Commission had not left Europe. We waited there some weeks, unpacking our cases, getting everything into carrying loads, and overhauling our instruments, camp equipment, etc.

On the 20th November we left Lokoja on a Niger Company's stern-wheeler, and in six days reached Jebba. Here five days were spent endeavouring to get longitude by telegraph from Lagos. It seemed impossible however to get messages through under several hours, so the attempt had to be abandoned.

On the 1st December we left Lokoja with a flotilla of 20 canoes,

* The British Commissioner was Bt.-Lieut.-Col. G. S. McD. Elliot, R.E., the Assistant Commissioners at first being Lieuts. C. H. Foulkes and G. R. Frith, R.E. Later on Lieut. G. F. Evans joined, together with Corpls. Healy, Archer and Kingston and Sapper Johnson, R.E. Lieuts. Foulkes and Frith and Corpl. Archer were invalided home in October, 1903.

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collected by the Officer Commanding the post there, and started to pole up against the current to Dole, where our frontier crossed the Niger. This place we reached on the 26th after a wearisome journey.

The river was falling; and as our canoes were not large enough to sleep in, we had to camp among the swamps along its banks, which swarmed with mosquitos.

Our rate of progress was about 10 to 15 miles a day. The canoes were propelled against the current by poling. Paddles were only used when it was necessary to cross the river at bends, so as to get away from the side where the current ran deep and strong to that where the water was shallow and less swift. In many places both sides of the river were equally unsuitable, and then the canoes were hauled up stream by pulling on the overhanging branches that fringed the banks, a very unsatisfactory mode of progression. Worse than this however were the reaches where the river ran deep between banks of reeds. Here cross pieces were lashed to the heads of the poles to enable a purchase to be taken and the canoe was forced up close along the banks by pushing against the reeds. We found occupation in repelling the attacks of the mosquitos dislodged by this operation.

We were glad to get rid of our canoes at Dole, which is on the left bank of the Niger a little above Illo. It is a village of reed huts surrounded by a stockade of hard wood logs, lying a little way up a creek to which it gives its name and which is the mouth of the Dallul Mauri. At this point the Niger is bordered for a mile or two on each side by reedy swamps. Wherever the ground is firm fan palms grow. These are very plentiful round Dole, and run up the Dallul Mauri to some distance above Yelu; they require moisture however, and disappear where the country gets drier. For this reason too they are only found along the centre of the Dallul Mauri, and are in many places the best way of recognising where the bed of that depression lies.

When we reached Dole the Harmattan wind was well established. The air was thick with a yellow dust haze. The view was limited to about a mile or two all round and consisted of little but fan palms and reeds.

The Convention defined the frontier as starting from the bank of the Niger and following the median line of the Dallul Mauri. What was the Dallul Mauri was at first a disputed point. Major Lang-Hyde, C.M.G., R.E., had set this matter at rest by a survey he made from Dole to above Beibei in 1900, after he had completed the demarcation of the boundary west of the Niger.

Given the Dallul Mauri, a further question arose as to what was its median line. A description of the Dallul Mauri will explain this difficulty. Following the Dole Creek up from the Niger we find it ends in a line of marshes, dry (or nearly so) at the time of our visit,

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with fan palms in abundance along their borders. Soon laterite scarps appear on either hand, and these and the country round are covered with thorny bush. Large forest trees are at first plentiful, but they gradually disappear as one gets further up away from the Niger. Opposite the village of Banna, the depression we have been following bifurcates. The westerly branch is known as the Rafin Foga or Valley of Salt, and this really is the correct name for the depression all the way down to the Niger. Dallul Mauri is the name given by the natives to that part of the easterly branch that lies in the Arewa or Mauri country, which is not entered till we get nearer Bale, a good deal further up.

In the Rafin Foga are salt workings. The method of obtaining the salt is the same as that practised in the salt desert in Bornu. After the rains, when the marshes begin to dry, the salt workers leave their homes, often many days' journey away, and come and camp in temporary villages built of palm leaves and generally placed on the spoil heaps left by their predecessors. They scrape up the soil from which the water has just dried and fill it into strong baskets, shaped like inverted truncated cones, placed in frames over earthen pots. Water is poured in at intervals and the brine is caught in the pots. These are taken away and the water is evaporated by boiling. The resulting salt is far from palatable to Europeans, and looks very yellow and dirty. A good trade is however done in it.

Above the junction of the Rafin Foga the scarps disappear on the west of the Dallul Mauri and their place is taken by rolling bush-covered undulations. After passing Nasserawa the Dallul Mauri can be traced with difficulty, but this was not of much importance as far as the demarcation of the boundary was concerned for the arc had intersected its median line before Beibei was reached. The difficulty about the median line was to determine whether it was to be considered to lie midway between the crests of the scarps or watersheds on either hand, or whether it was the middle of the line of marshes. Both were equally hard to define, as neither the scarps nor the marshes were continuous. A compromise was therefore resorted to.

From the beginning of the arc right round to the Chad the whole of the frontier lay along the fringe of the desert, and, though crossed in places, had not previously been traversed by Europeans. It is an uninviting region of deep sand covered with thorny bushes, unrelieved by any striking features and rendered still more wearisome by the haze of dust which hangs over it while the Harmattan is blowing.

There appear to be evidences that the desert is extending to the southward. One of these seems to me the fact that the limits of certain trees, notably the shea butter-tree and the baobab, may almost be defined by parallels of latitude. It looks as if the country were once well forested; and that, as the rainfall gradually diminished, the trees requiring the most moisture were the first to disappear, whilst

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the hardy varieties continued to exist a while longer under the changed conditions. To make this argument complete it would be necessary to find remains of the other varieties north of the zones where they now exist. I daresay some of the fossil roots and plants which our French colleagues have brought home may supply the proofs that are wanting.

Stronger evidence than this, however, is to be gained by a study of the physical features of the country. There are no water-courses or valleys drained by streams. The little rain that falls seldom flows far along the surface; it either soaks into the ground at once, or forms pools which dry up for the most part a few weeks after the rains are over. The Dallul Mauri is a fair example of what were evidently old water-courses, that are to be met with throughout this region. Originating, seemingly, along a line of fault in the laterite sheet that covers the country, it became the valley of a river draining into the Niger basin. In course of time, as the rainfall decreased, the prevailing winds, charged with sand from the desert, blocked its channel with dunes which its then dwindling current had not the power to sweep from its path; marshes were thus formed along its course, and they in turn collected less and less water as the rainfall decreased in the areas that drained into them.

That the rainfall was once considerably greater than it is now is evinced by a series of deep water-worn valleys that divide up the laterite surface to the S.E. to Tawa. These are about 100 to 200 feet deep, and a mile wide in parts. They were evidently river valleys, but like the Dallul Mauri no stream now drains their entire length. Such water as flows in them in the rains sooner or later finds its way into pools and marshes, few of which contain water through the dry season.

These deep valleys are interesting too in another way. The geological section exposed on their sides shows the laterite sheet to overlay shales and chalk. The latter is full of fossils, a large number of echinoids among them, which have been identified as belonging to Eocene times. This is a point of considerable importance as it shows the vast extent of this Eocene sea, which, to judge by the similarity of these fossils with those found in Northern Africa, Arabia, Sind and Baluchistan, seems to have included the Mediterranean, the Saharan part of Africa, Egypt, Arabia and the N.W. of India, and to have extended as far south as Sokoto, if not further.

Leaving the evidences of the past, we may turn to what we can see going on to-day. We have the fringe of the desert inhabited by a people mainly pastoral. There are, as is well known, no more deadly enemies to forests than the native shepherd and his goats. The former, with the axe he always carries, wantonly hacks the trees about to satisfy his most trivial needs or cuts down their branches to feed his flocks; while his goats love to bite off young shoots and

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particularly the tops of seedlings. In addition there is the damage done every year by the forest fires when the old grass is burnt to make way for the new.

The method of cultivation too is most wasteful. To clear the ground the smaller trees are cut through at about the height of a man's waist; the larger ones are ringed. When the branches are dry they are burnt, being piled, if necessary, round the ringed trees, which are consumed with a completeness that is astonishing. The field, dotted over with stumps, which render ploughing impossible, is now ready for the hoe. When the ground is exhausted fresh fields are prepared in the same manner. The country was thus steadily being deforested under native rule.

With diminution of vegetation goes diminution of rainfall. The prevailing wind is the Harmattan. This commences in October soon after the rains cease, and is well established before November is out. Thence till the end of March or middle of April it blows without intermission from the north-east; and the air during its continuance is so heavily charged with fine sand that one exists in a sort of fog, and vision is limited to two or three miles, and occasionally to half a mile or less, a state of affairs very unfavourable for surveying and disagreeable from every point of view. Nothing is free from this sand; and coming straight up from the moist Niger valley to this extremely dry and dusty region was very trying and caused a certain amount of sore throats, earaches and other annoyances till one got accustomed to it. From April to June, when the rains fairly break, the Harmattan is still the prevailing wind; but there are intervals of a few days together when the air is clear, the wind blows from other quarters, clouds due to water vapour instead of dust are to be seen, and even a few drops of rain fall. It can readily be conceived how a wind like this, ever carrying before it in the same direction the loose particles from the soil that has lost its protective covering of vegetation, is busy before our eyes in changing the face of nature, slowly, it is true, but steadily and surely. The lee side of every bush and rock becomes the starting point of a sand dune, and naturally hollows and bends in the river courses are the first to get blocked. The process of deforesting thus acts in a twofold manner on the drainage of the country. It diminishes the rainfall and consequently the volume and strength of the currents; and it lays bare the soil to the depredations of the wind, which thus more readily gathers the material to block the channels. Before leaving this subject I must guard myself against seeming to imply that the influences I have just enumerated are the ones that have mainly operated to bring about the great change that has undoubtedly taken place in these regions. The vast sheets of inland water, remains of the Eocene sea referred to above, must, while they existed, have contributed very largely to the rainfall of the interior of Africa; and the water-worn valleys were

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doubtless carved out in a great measure during their time. Naturally, as they dried the climate and conditions gradually changed. I have merely been trying to explain my reasons for thinking that the view that the desert is extending southward has every probability of being correct.

After leaving the lower portion of the Dallul Mauri near the Niger, no surface water was encountered along the frontier till the Salt Desert was reached. In the rains, after a shower, the ground was running with water for a few hours, and the forest pools filled up, but there is no stream that has water in it throughout the year. Even the river we crossed several times when marching from Maradi to Katsena, and over which we got our caravan with some difficulty, dries entirely, I believe, between the rainy seasons. As far as my knowledge goes this river flows past Sokoto. Near that town there is water in it throughout the year, but this is some distance from the frontier.

The water supply of the country is all from wells, usually over 60 feet and sometimes much more in depth. In some places the water is charged with salts and is most disagreeable, but it is usually good, though muddy when first drawn. The natives seem to despise any sort of wheel, inclined plane, or other mechanical contrivance whatever, to enable them to draw the water with greater ease. They lower their vessels, either pots, gourds or skins on an iron ring, into the wells by ropes, and pull them up again by hand. The ropes, it is true, rubbing on the hard wood logs lining the top of the well, cut deep grooves, and this perhaps is of some little assistance.

Large flocks of sheep, herds of cattle, horses, everything in the village or town, depend for water on these wells. The labour of supplying them is considerable. A horse usually takes several hauls of water before he is satisfied. Round the wells are troughs made of hollowed-out logs into which the water is poured for the cattle. There is often a rough fence to keep the animals from the edge of the well, but even then the sanitary conditions are not ideal. Worse still are they when the rains have commenced and the wells can no longer be used, as, being lined for only a short distance from the top, the sides are apt to fall in if weight is brought on them when sodden with water. Then recourse must be had to the surface pools, the catchment for which is the village and its neighbourhood.

I have referred to the Salt Desert. This lies, roughly speaking, round the second crotchet made by the frontier, where it regains the parallel of 14° N. from that of 13° 20′ N. The name has an uninviting sound; but compared with the monotonous tracts of heavy sand or laterite covered with thorny bush, through which we had been passing during so many months, it was a relief to the eye to get out on to wide open plains covered with grass and diversified occasionally by lines of borassus palms. True, the soil was sand as heavy as ever,

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the grass was dry and full of horrible burrs, and the Harmattan, for it was the end of November, had again cast its yellow veil over the landscape; yet all the same there was a sense of freedom that was lacking where the view was restricted to a few yards of monotonous bush, inhabited by little else but grey hornbills, whose dismal notes seemed most appropriate to their surroundings.

The curious feature of the Salt Desert was the pans or hollows that are dotted about it. There is nothing in the open undulating plain to denote the presence of these, and one is unaware of their existence till right upon them. Some of the hollows were dry or drying, others contained water deep enough for hippopotami. Round the edge of the water is usually a dense border of handsome feathery reeds, and on the firm ground outside these a belt of borassus palms. These pans were of varying sizes and shapes, sometimes roughly circular, about half-a-mile to a mile across, and 100 feet or more below the general level of the surrounding country. To our eyes, unaccustomed to the sight of water in the landscape, they were a welcome sight. In such of the pans that the water dried from, a deposit of salt or potash was left. The salt was obtained in the same way as in the Dallul Mauri.

After leaving the Salt Desert we struck down to the Yo river and followed its course to the Chad, which was reached on the 26th December, 1903, exactly a year from the day we reached Dole on the Niger, where our work began.

The appearance of the lake is disappointing. No vast stretch of open water meets the eye. On emerging from the bush which skirts its shore a grassy plain is entered from one to several miles in width; beyond this are marshes as far as the eye can reach. The shores are so low that it is impossible to get an extended view. There are no native boats that are able to cross the lake. The Boudouma, who live on the lake, make canoes of bundles of reeds lashed together, forming a sort of raft tapering to the ends. The gunwales are formed of similar bundles made fast round the edge of the raft. These vessels, however, are only suitable for poling round the edge of the lake, and dare not venture into the open, where it is often very rough. On the western shore we noticed that at night, when the Harmattan usually died away, the waters receded some hundreds of yards, being piled up during the day by the strong north-east wind.

Game was plentiful on the grassy plain bordering the marshes, but though the number of animals was large there were not many varieties. Korrigon (the Senegal hartebeeste), cob, several kinds of gazelles, elephants and ostriches were seen and shot, and there were numerous traces of hippo. A wart-hog was also ridden down and stuck. No traces of lions were seen; and hyenas, which were plentiful enough further west, did not appear to be much in evidence on the shores of the lake. Buffalo, that once existed, appeared by native

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accounts to have been killed off by sickness of some sort. Giraffe tracks were seen a few miles from the lake, but none of the animals themselves. Compared with other parts of Africa, Northern Nigeria does not appear to be remarkable for the numbers and variety of its big game.

The methods of survey adopted were dependent on the political situation as well as on the nature of the country and the climate. When we arrived at Dole, where our work began, the ruler of Sokoto was hostile, and it would not have been possible to go there without a larger escort than we had. My instructions were not to go nearer that place than Argungu till the Expedition, which was shortly to start, had dealt with it.

Argungu was the headquarters of a small Column that was employed in watching Sokoto, and in passing French convoys from the Niger for Zinder through the upper part of the arc and consequently through British territory. The roads outside the arc were impracticable, except in the rains, for want of water; and pending the settlement of the boundary the French were allowed as a temporary measure to use the roads in our territory. They had, however, in 1903, made a practicable route from Filingi (about in the left-hand top corner of the map) to Tawa by sinking wells along it at intervals. This was a very creditable achievement, carried out in the face of considerable difficulties.

The latest Convention has given them a slice off the top of the arc so as to let them have the road they wanted,—roughly through Matankari, north of Tolleh and Sabun Birni, south of Maradi, and into the parallel of 13° 20′ N.

Captain Merrick, R.A., was in command of the Argungu Column, and he and his officers between them had marched round the arc and made reconnaissance sketches which proved very useful. Later on work had to be organised from maps compiled from native information, a tedious process and not very accurate, but certainly interesting, as the result depends partly on one's own skill in making the meaning clear and partly on the habits of observation and intelligence of the people questioned. At such a time one realises the value of any information that is correct as far as it goes, and how important it is that travellers in little known countries should make careful notes of their journeys, even though they may not have appliances or opportunities for making good maps.

How to survey the arc was the first question to be considered. Sokoto, the centre of it, was for the time unattainable; but we had been supplied with the co-ordinates of a conventional centre that we had been directed to adopt. These had been arrived at by taking the means of the observations of the various travellers who had visited the place, and the position thus given proved to be not very far from the actual centre of the town.

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Various circumstances combined to decide the eventual method of surveying the arc. It was as follows :—

(i.). Triangulation near Beibei and Junju with a line of latitudes and azimuths to Matankari.
(ii.). Line of latitudes and azimuths from Tawa to Sokoto.
(iii.). Triangulation in the neighbourhood of Buza and Chara.

On these three sections occultations were observed as follows :—
On (i.) 1 at Junju, 1 at Beibei and 2 near Matankari ; on (ii.) 2 at Illela, 1 at Tawa ; on (iii.) 3 at Buza.

All the intermediate ground was sketched in between the points so fixed ; and frequent latitudes and longitudes by watches were taken.

Had the three sections above mentioned been connected by some more accurate system of survey, such as a triangulation or a careful traverse, it would have been possible to use the mean of all ten occultations for the determination of longitude. The nature of the country and the state of the atmosphere would however have made this a long and costly operation, and the circumstances did not appear to demand it.

The sketches were nearly all made with the prismatic compass ; and distances were measured by wheels fitted with cyclometers, such as are used on bicycles. By first checking these wheels over a measured distance, so as to estimate what correction should be made for the little deviation from a perfectly straight path and also for a certain amount of slipping unavoidable in bush and heavy sand, very satisfactory results were obtained. The surveyor marched with some portion of his caravan at any rate well in front of him. The road could seldom be gone over twice ; and usually the only way to see where the narrow bush path was going was to observe on the people winding along it ahead. The magnetic variation was very steady ; and this was fortunate, as, owing to the flat bush-covered nature of the country and the hazy dust-filled condition of the air for the greater part of the year, we were forced to depend on our compasses.

We took frequent azimuth observations to check the magnetic variation, and found it to change steadily from about 14° W. near the Niger to 10° W. near Lake Chad. This corresponds very well with the lines of equal magnetic variation shown in the chart opposite page 82 in Vol. I. of the Royal Geographical Society's *Hints to Travellers*, 1901.

As regards astronomical observations, longitude was of course the main difficulty. We relied for absolute longitude on occultations of stars by the moon. The French stipulated that we should have at least three observations in one place and take the mean before we could consider that place properly fixed in longitude. This was by no means an unreasonable condition, as anyone who has studied the question will admit ; but it was far from easy to fulfil, because, for an

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occultation to be of any use, the conditions must be very favourable, —a clear sky, not too bright a moon, and star entering the dark limb at a suitable angle, *i.e.*, travelling as it were towards the moon's centre and not on a path approaching a tangent to its disc. Emersions from the dark limb were also observed; but these are not so satisfactory, as the exact moment of the reappearance of the star is harder to get than its disappearance.

In several instances we got over the difficulty about getting three occultations in one place by connecting points where occultations had been observed by a triangulation; or, if they lay north and south of each other, by lines of latitude and azimuth, or by a combination of both these methods. The method of latitude and azimuth has much to recommend it when following a nearly north and south line.

We got our intermediate longitudes by carrying time with us. We had seven deck-watches, half chronometers, such as are used at sea. Observations for time were taken nearly every night. We found that, though few of the watches had a really very good rate, yet the error on Local Mean Time as given by the mean of the corrected watch times was very fairly constant. The watches have to be treated with the greatest care possible. They must always be wound at the same time and kept in the same position. After a halt they take up a different rate when the march is resumed, and this not at once but during an interval of some days; and similarly when halting after a march. The best way to get over this difficulty is never to let the watches halt. Every day that is spent in halting, the watches should be carried round the camp till they have traversed a distance equal to an average day's march, as much as possible under marching conditions. This of course has to be done under proper supervision. Careful men should be selected to carry the watches; they should receive a special rate of pay, and be impressed with the dignity and importance of their task and also with the fact that the watches, if not properly treated, will tell their own tale.

If this system is pursued, only the marching rate of the watches need be known. The best way to obtain this is to return after some days' marching and surveying to a camp where time observations have been taken, and take them again. If the conditions of work allow of it, a very good method, one practised by a very painstaking French officer, is to progress in a series of circuits (closing his polygons, as he expressed it) and take time observations whenever revisiting a spot where they had taken them before. A modification of this somewhat rigorous method will however be more usually practicable.

After the day's march, watches have to be wound and compared, and observations taken for time and latitude, and sometimes for azimuth. Though each of these operations is not in itself lengthy

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when practice has made the observer expert, yet, even under favourable circumstances, a considerable amount of time is occupied in waiting for stars to reach the desired position, and the work to be done at night is an appreciable addition to the labours of the day.

In places triangulation and latitudes and azimuths were, as I have said, resorted to; but the bulk of the work was compass sketches checked by as careful astronomical observations as were possible. I had much more ambitious ideas when I first started, but found that my feelings as a surveyor had to yield to a common-sense view of the case. Any other method than the one adopted would have taken very much longer, and the whole party might have been forced to return to England and go out again for another tour. The instructions given me before starting admitted of the possibility of my having to do this, but it would have added enormously to the expense. As it was five officers and one N.C.O. were sent home sick from the Boundary Commission.

The field sketches were done to a scale of $\frac{1}{100000}$, and the maps compiled in the field were to a scale of $\frac{1}{250000}$. This compilation was effected by plotting the ordinates of the points fixed by astronomical observations on graticuled sheets of that scale, which we had brought out with us, and reducing and fitting the sketches in between these points.

After returning home all calculations were worked out again, those for the occultations with the observed co-ordinates of the moon; and the maps were re-compiled to a scale of $\frac{1}{250000}$.

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TABLE OF OCCULTATIONS, 1903-4.

OBSERVED BY ANGLO-FRENCH BOUNDARY COMMISSION.

Date.	Place.	Condition of Moon.	Star. Name.	Star. Magnitude.	Correction to Moon's Tabular R.A.	Correction to Moon's Tabular Δ	Longitude by Tabular Co-ord.	Longitude by Observed Co-ord.	Adopted Longitude.	Immersion or Emersion	Remarks.
1903.					s.	"	h. m s	h. m. s.	h. m s.		
10th Jan. ...	Beibei.	Full on 13th Jan.	ι Tauri.	5·1	+0 54	±0	0 15 32·63	0 15 38·5	0 15 33·76 E.	Imm.	Final positions of Beibei, Junju and Rumboki obtained by combining results of occultations observed at these three places.
12th ,, ...	,,	,,	D.M.+17 1479.	6·2	+0·51	+0·4	0 15 34·83	0 15 44·3		Imm.	
6th Feb ...	Junju.	1st qr., Feb. 4th.	ζ^3 Tauri.	4·2	+0·49	+2·4	0 14 4·85	0 14 13·6	0 14 7·29 E.	Imm.	See remark opposite Beibei.
8th Mar. ...	Illela.	1st qr., 6th Mar.	D M.+17 1479.	6·2	+0·79	−1·8	0 20 55·68	0 21 4·7	0 21 0·6 E.	Imm.	
19th April ...	,,	Last qr., 19th April.	β Capricorni.	3·2	+0·14	−0·3	0 20 55·36	0 20 55·3		Imm.	
6th May ...	,,	1st qr., 3rd May.	76 Leonis.	6·5	+0·49	−1·2	0 20 54·78	0 21 1·8		Imm.	From occultation observed at Tawa and connected with Illela by line of Lat. and Az.
1st ,, ...	Buza.	,,	B.A.C. 2116.	,,	+0·46	−0·3	0 24 7·5	0 24 17 8	0 24 17·6 E.	Imm.	
6th ,, ,,	,,	,,	76 Leonis.	,,	+0·49	−1·2	0 24 6·28	0 24 17 5		Imm.	
14th ,, ,,	,,	Full moon, 11th May	Y Sagittarii.	var.	−0·14	−0·1	0 24 9·3	0 24 5·9		Em.	Rejected.
8th July ...	Rumboki.	Full moon, 9th July.	B.A.C. 6287.	5·7	−0 13	−0·3	0 15 57·91	0 15 58·2	—	Imm.	*Vide* remark opposite Beibei.
10th ,, ...	,,	,,	β Capricorni.	3·2	+0·03	−0·1	0 16 39·16	0 16 3·5		Imm.	
10th ,, ,,	,,	,,	,,	,,	,,	,,	Not calculated.	0 16 10 9	0 16 8·2 E.	Em.	
30 h Oct. ,,	Maikeuri.	1st qr., 27th Oct.	B A.C. 7804	6·1	−0·03	−1·12	0 35 48·44	0 35 50·88	0 35 48·43 E.	Imm.	
3rd Nov. ,,	,,	Full moon, 4th Nov.	o Piscium.	4·5	−0·09	−1·79	0 35 14·87	0 35 47·95		Imm.	
3rd ,, ...	,,	,,	θ Aquar.i.	4·3	,,	,,	0 35 37·30	0 35 46·45		Em.	
6th Dec. ...	Kania.	Full moon, 4th Dec.	D.M.+17 1479.	6·2	+0 07	−0·3	0 44 37·53	0 44 39·07	0 44 38·5 E.	Imm.	
13th ,, ...	,,	Last qr., 10th Dec.	π Virginis.	5·3	+0·05	−1·00	0 44 36·94	0 44 38·08		Imm.	
31st ,, ...	Kukawa.	1st qr., 26th Dec.	63 Tauri.	5·6	+0·5	+1·5	0 54 7·42	0 53 53·57	0 53 52·46 E.	Imm.	
1st Jan. 1904	,,	Full moon.	119 Tauri.	4·6	+0·6	+1·4	0 54 6·06	0 53 51·25		Imm.	

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THE DESIGN OF TALL CHIMNEYS.

By MAJOR C. AINSLIE, R.E.

HAVING lately had to deal with several projects for tall chimneys, I have found that designs based on a formula used by a well-known engineering firm appears unsatisfactory when tested by the method given on pages 319 and 320, Part I., of *The Principles of Structural Design* by Bt.-Colonel G. K. Scott-Moncrieff, R.E.; and I should like to see a discussion on the subject. To illustrate my point I will take the chimney given on *Plate* VIII. of that book, viz., one 100 ft. high, with top and bottom external diameters of 7′ 10″ and 13′ 8″ respectively and thickness of brickwork varying from 14″ to 2′ 3″ (a batter of ·03 in a foot).

In designing a chimney, the height is first settled with reference to the coal consumption, the height of the station above sea level, and any special local conditions and regulations. The area of the flue is then determined by one of the formulæ connecting the height, flue and grate areas. The thickness of brickwork at the top depends on the diameter of the flue at the top, 9 inches being taken for flues up to 4 ft. 6 inches diameter. The chimney can then be drawn with a batter of not less than 2½ inches in 10 ft. (by London County Council rules), and the brickwork arranged in offsets of 4½ inches at every 25 ft. or less to suit the required size of the flue. The weight of brickwork is then taken out, and calculations made for stability and for the foundations. I do not propose to deal with the last named.

According to the formula used by Messrs. Babcox & Wilcox (page 328, *Electrical Engineering Formulæ*, 2nd edition, Geipel & Kilgour), the weight of the brickwork in lbs. must not be less than $\frac{C \times d \times h^2}{b}$,

where b is the diameter (external) at the base in feet, h the height in feet, d the mean diameter (external) in feet and C a constant of 56 for square, 42 for octagonal and 28 for round chimneys, representing the wind pressure in lbs. per square foot. If this formula is applied to the chimney given on *Plate* VIII. it gives W = 98·4 tons, and as the actual weight is 255 tons there is a large margin of safety.

If we disregard the local conditions of that chimney as to the foundations and imagine it built on solid rock, the base might be reduced to 12 ft. in diameter, giving a batter of 1 in 48. Such a chimney, built with a top ring of 14 inches and 4½-inch offsets at

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every 25 feet, would weigh roughly 491,800 lbs. against 231,450 lbs. required by the formula quoted, showing still a large margin of safety. But this particular chimney could not be made lighter, as the 14-inch thickness at the top is required for the flue, which is $5\frac{1}{2}$ feet in diameter.

If such a chimney is checked by Colonel Scott-Moncrieff's method, we get—

Moment of Inertia $= \cdot 7854\ (6^4 - 3 \cdot 75^4) = 862$ ft. units,
Weight $= 220$ tons approximately,
Area of brick ring at base $= \cdot 7854\ (12^2 - 7 \cdot 5^2) = 68 \cdot 5$ sq. ft.,
Overturning moment at base $= 100 \times 9 \cdot 92 \times 50 \times 28$ ft. lbs. $= 620$ ft. tons,
with 56 lbs. wind pressure per sq. foot.

Thickness at base $= 12$ ft.

And $y = \frac{220}{68 \cdot 5} - \frac{620 \times 12}{2 \times 862}$ tons per sq. ft. $= 17$ lbs. per sq. inch tensile stress.

This is not more than good mortar could stand, although the limit given on page 38 of the same book is 14 lbs. per sq. inch.

If, instead of $\frac{56}{2}$ ft. lbs. of wind pressure, we put X, we get $X = 21 \cdot 33$; that is to say the mortar will not be exposed to tensile stress up to a wind pressure of 43 lbs. per sq. foot only. I cannot find it stated anywhere what tensile stress on the mortar is admissible with the formula $W = \frac{C \times d \times h^2}{b}$; but I should think little, if any, especially as cement mortar is not recommended for the lower half of a chimney which is exposed to great heat (page 330 of Geipel & Kilgour).

If we take the case of a chimney with a small flue, the difference is more marked. Take for instance a design I have lately had to deal with (A). In this the height is 85 ft., diameter of flue 2 ft., thickness at base $8\frac{1}{2}$ ft., thickness of brickwork at the top 9 inches, with offsets of $4\frac{1}{2}$ inches at every 14 ft. The weight of such a chimney is approximately 242,300 lbs.

By the formula $W = \frac{C \times d \times h^2}{b}$ the required weight is about 142,800 so the chimney is stable. But if tested by Colonel Scott-Moncrieff's method the tensile stress on the mortar at the ground line, with a wind pressure of 60 lbs. per square foot, is about $42\frac{1}{2}$ lbs. per square inch, or 37 lbs. with a wind pressure of 56 lbs. Surely the trade formula does not contemplate such a tensile stress. Yet the design is well within the conditions laid down by the London County Council; the batter is only 1 in 34 and the base $\frac{1}{10}$th the height.

I have worked out a chimney of this height with a diameter of 7 ft. 1 inch at the base (*i.e.*, a batter of 1 in 48 and a base of $\frac{1}{12}$th the height), the thickness of brickwork at the top being 9 inches, with

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4½-inch offsets at every 20 ft. except the lowest length of 25 ft. Such a chimney weighs 177,400 lbs. against 161,900 lbs. required by the above formula, and conforms to the London County Council rules; but shows a tensile strength of 78 lbs. per sq. inch on the mortar with 60 lbs. wind pressure, and a crushing stress of ·71 tons per sq. inch (B). What conclusion are we to draw from this?

The formula $W=\frac{C.x.d.x.h^2}{b}$ quoted above is evidently arrived at by equating the moments of resistance and the overturning moment, taken about the leeward edge of the ground line section. For $M_r=Wx\frac{d}{2}$ and $M_o=h.x.dx\frac{h}{2}xC$, the wind pressure being considered to act on a plane equal to the mean external diameter at half the height, and being taken at 28 lbs. per sq. ft. for round chimneys, 42 lbs. for octagonal and 56 lbs. for square chimneys. There does not seem any objection to taking the moments of resistance and overturning moments about the leeward edge, provided the crushing stress at the leeward edge is not more than the bricks can stand safely. Take for instance the chimney designed as at (A) above, and calculate the crushing stress at the leeward edge by Colonel Scott-Moncrieff's method. Here we have

Moment of inertia at base	$=·7854(4·25^4-1·55^4)$	$=250$ ft. units,
Overturning moment at base	$=85\times6\times42·5\times30$	$=290$ ft. tons,
Weight	$=242300$ lbs.	$=108·2$ tons,
Area of brick ring at base	$=·78(8·5^2-3·1^2)$	$=49$ sq. ft.,

Crushing stress $=\frac{108·2}{49}+\frac{290\times8·5}{2\times250}=7·14$ tons per sq. ft. or ·05 tons per sq. inch; so there is no fear of crushing.

Looking at the great difference in weight of chimneys designed by the two methods and the stresses given at (B) above, I am forced to the conclusion that Colonel Scott-Moncrieff's method gives unnecessarily heavy chimneys, and I am led to ask where the neutral axis of a chimney lies. Surely not up the middle of the shaft, which his method seems to require? I have not worked out the calculations for the chimneys given on page 438 of Molesworth's *Pocket Book of Engineering Formulæ*, 24th edition; but I feel sure, from the heights and diameters given, that these chimneys are very much lighter than Colonel Scott-Moncrieff's method would require.

From a study of pages 234 and 235 of *The Principles of Structural Design*, I am inclined to think that the overturning moment is really less than that taken in both the Babcock and Wilcox and Scott-Moncrieff methods. In these pages we are told that the wind pressure up to a height of 15 ft. is low, and at 100 ft. is only about 42 lbs. per sq. ft. Considering that the diametral plane of the chimney is greatest

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where the wind pressure is least and *vice versâ*, may not the overturning effect be much less than half the maximum pressure (say 60 lbs.) acting at half the height on a diametral plane equal to the height multiplied by the mean diameter ?

Can anyone tell me what is the real effect of wind pressure, as determined by experiment, on chimneys which are built

(*a*) on fairly level ground ;

(*b*) on uniformly sloping ground ;

(*c*) on a narrow spur, with steep slopes on both sides and a fairly steep slope up and down the spur.

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TYPHOID AMONG SOLDIERS IN THE FIELD.

THE ravages caused by typhoid among soldiers in the field have long been a constant cause of weakened numbers, embarrassing to commanders, distressing to the nation, and the despair of the medical branch of the army. No other disease, short of an epidemic, is so widespread and so constant. The matter is one which should be of vital interest to all officers who have to command men or administer camp services. It is believed, therefore, that a short *résumé* of the facts connected with typhoid in the American army during the Spanish war may be of more than merely local or technical interest to laymen. The facts are of course well known to the medical profession.

Among the troops who volunteered in the United States in 1898 for the Spanish war typhoid soon made its appearance, and never ceased its ravages till the troops were disbanded six months later. The Board as far as possible investigated each case and each epidemic among the soldiers before they left the United States.

Out of the 108,000 men considered there were 20,738 cases of typhoid, and 1,580 deaths, against 252 deaths from all other diseases. The public was aroused by this state of affairs in the camps, and insisted on enquiry. The Board assembled by the War Department worked for some years on the subject, and their surviving member has now made a Report, of which the following remarks give the results.

Typhoid developed in from 3 to 5 weeks after the troops joined their first camp, and became epidemic in both small and large camps. Crowding seemed to have no place as a cause of typhoid, neither did the position of the camps, nor the water supply. The results of the investigations conclusively controvert the theory that camp diarrhœa can in itself conduce to typhoid. It appears that inoculation by a specific typhoid germ is necessary.

Typhoid is of such frequent occurrence in civil life that the chances are that in any camp, however perfect sanitarily, one case would develop among every 1,300 men assembled. It seems certain that each case becomes at once a centre of infection, so that the disease spreads rapidly.

Typhoid is only spread by the transference of germs from the excreta of an infected patient to the alimentary canal of another. This transference may take place by direct contact, or with food or water swallowed, or by indirect contact with fouled and infected bedding, tentage, clothing or seats, while fouled hands may infect

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pipes, knives, forks, spoons, utensils or food. It must be noted that a patient may spread infection *before* he is recognized as suffering from the disease. He is a source of danger from his excreta during the incubation period, which is from 8 to 10 days.

The proportion of typhoid cases was nearly one-fifth of the force in the six months during which the troops were out, and 14·63 per thousand of the troops, or one in thirteen of the cases, died of this disease.

It is probable that in any body of troops at least a quarter are susceptible of contracting typhoid. The spread of this disease is certain to occur wherever soldiers are massed together, unless rigid precautions are taken. It is important that all officers should know what these precautions are, and should realize the certainty of the spread of typhoid if they are neglected. They will thus be able to impress vividly on their men the necessity of cleanliness for good health ; this is far more important than care over food and water.

The whole evil springs from camp pollution. Camps should frequently be changed, and they cannot be too carefully cleaned. Every camp must firstly be capable of being drained of all surface water, lest the surface become fouled with excreta. The disposal of excreta is the most important matter in camp ; no flies must be allowed to settle on them. No pollution of the ground, or of tents, or of boots must take place ; any system of removal in carts or tubs is liable to pollute the ground. The pit or trough should be disinfected ; burning petroleum is largely used for this in the U.S. manœuvre camps. Unwholesome water seems to have played but a small part in the epidemic. The only remedy is for the command to move camp, and disinfect all clothing, tentage and bedding. No second camp should be made on the site of a former one, or typhoid is sure to break out.

With regard to the individual soldier, his personal cleanliness is most important. His outer clothing should be removed at night, and his bed raised if possible from the ground. No man who is unwell should ever be employed in the cookhouse, as is very often the case.

These matters lie within the province of the officers commanding bodies of men to deal with. The medical officers can only advise. To back up their advice some general knowledge of the facts of the transference of typhoid, and of its deadly ravages, should exist in the army. This matter has already been taken up by the Indian Medical Department, which has issued a most useful pamphlet as to safeguarding the soldier in camp.

It is hoped that the results of the above-mentioned Board may hasten the time when (as said in their Report) Governments may "learn that military campaigns should be conducted in accord with hygienic rules, and that the officer who needlessly and ignorantly sacrifices his men to disease is as unworthy of his position as one who makes a like sacrifice in the face of the enemy."

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CONCEPTIONS OF MATTER:—ANCIENT AND MODERN.

By MAJOR W. R. LANG, R.E. (VOLS.) AND CANADIAN MILITIA.

THE science that deals with the constitution of matter has occupied the time and energies of countless generations of men since the time of Adam, who, possibly, was himself an alchemist, as one might be led to believe when reading of

> "A book where Moses and his sister,
> And Solomon have written of the art."[o]

The quest of the alchemist was the production of new substances and the conversion of one form of matter into other forms by a process of transmutation. This was possible, he argued, because, in nature, plants and animals were seen to grow, change, develop and die, and that therefore the same growth and development ought to proceed in the mineral kingdom. Just as a grain of seed in the ground died, and from its dead body arose the perfect plant or tree, so, in the earth, the metals were looked upon as undergoing a growth and becoming more perfect—in time reaching the highest stage of all, namely, gold.

Alchemy did not give place to chemistry proper until the 18th century, and in its long life experienced many vicissitudes. Its students and followers were not merely natural but also moral philosophers; they regarded nature from both standpoints; watched and studied the course of nature as exemplified by the growth of living things, vegetable and animal; endeavoured to discover the secret of her workings, and trusted to be able to apply this secret to the transmutation of the baser into the nobler metals, to the production of an *Elixir Vitæ*, which would be the cure of all ills; and, as a result of this, hoped for the mental happiness which would follow from the practical knowledge of the supreme secret of nature. Their quest was for an undefinable something, called by various writers "*the one thing*," "*the philosopher's stone*," "*the essence*," "*the soul of all things*," and by many other names.

Though some alchemists believed in the power of this "essence" (which was presumed to have a dual nature, material and spiritual),

[o] *The Alchemist:* by Ben Jonson, 1610.

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to create things, yet the best writers seem to have had a real belief in the Supreme Being as alone having power to create and destroy; they hoped only to make one form of matter into a different form, not to create it. That this could be done they believed implicitly, and a simple illustration will show how far their belief was justified. The mineral galena, which is a sulphide of lead containing some silver, has somewhat the appearance of the metal lead itself. When subjected to treatment, it yields lead; and the lead in turn, on heating and removing the "calx," or earthy material formed, disappears, leaving a small portion of the precious metal silver. The alchemist took no consideration of the relative *quantities* of original material and the residual silver obtained: he used his results to confirm his preconceived theory of the transmutation of the baser metal, and did not, as would have been more logical, deduce a theory from his experimental results. The alchemist's belief remained firmly fixed in his mind, was, indeed, a part of his system of ethics, not only from the example just given but from his observation of nature. That lead could not, by one wave of the alchemistic wand, be converted at once into gold he quite understood; a series of purifications, of "trying in the fire," was required before the perfect metal was obtained. In *The Alchemist* this view is expressed in these lines:—

> Nor can this remote matter suddenly
> Progress as from extreme unto extreme,
> As to grow gold, and leap o'er all the means.
> Nature doth first beget the imperfect, then
> Proceeds she to the perfect.

It was a far cry from the earlier alchemist to the chemists of the 19th century, or to the time when the ideas of transmutation had to give way—thanks to Priestly, Lavoisier, and others—to theories evolved from the results of careful investigation of the quantitative changes occurring during chemical operations. The enunciation of Dalton's hypothesis of atoms placed chemistry on a new basis, and was the commencement of an era of phenomenal progress in chemical science. According to this theory, matter is composed of combinations of the atoms of elementary substances, which unite together, by reason of their chemical affinity, to form molecules of new substances. Matter, therefore, is composed of minute indivisible particles of the same or of different elements, and of these everything that is apparent to the senses is made up. Cut and carve down these particles as you may, in the end there is left the uncuttable particle or atom of each element.

This hypothesis of Dalton's was by no means new; indeed he merely resuscitated a theory put forward more than two thousand years previously. These early philosophers—Democritus (B.C. 460),

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Lucretius, the Latin poet who was born about a century before the Christian era—attempted to connect the differences of size, shape and qualities of various forms of matter with the differences of size, shape, position and movements of what they termed the *atoms* of matter. Everything material, they held, was composed of "a coalescence of certain unchangeable and indestructible particles"; no atom of anything could either be created or destroyed; when substances ceased to exist, another was formed; no destruction of matter took place, merely a rearrangement of the atoms. The ancients were evidently as fully alive to the soundness of the doctrine of the indestructibility of matter as we are now. Their conception of its various forms coincides with the modern ideas also; a solid body consisted of a vast number of atoms squeezed closely together, a liquid of a less number more loosely connected, and a gas of a still smaller number able to move freely and distributing themselves uniformly throughout the space containing them.

The atomic theory, as enunciated by the Manchester schoolmaster (Dalton), was based on observations of the manner in which the elements combined with one another, namely in fixed and definite proportions:—the atoms of each element had a definite weight peculiar to all the atoms of that particular substance. This theory has served the purposes of chemists for the past century, and has been and still is a convenient quantitative method of expressing chemical changes as they occur. The chemist can calculate the amounts of material necessary for the formation of new combinations—alike in the factory as in the laboratory,—and can prophesy the yield he will obtain from the union of known quantities of different elements or compounds. But though the atomic theory has for so long been a perfect working hypothesis from the chemist's point of view, recent researches, depending mostly on the study of electricity and radio-activity, have led to the displacement of the atom from its position as the unit form of matter. The atom is slowly but surely being proved to consist of an aggregation of still smaller units (electrons, corpuscles or ions,—call them what you will), incapable of detection by ordinary chemical methods, but readily recognisable by the physicist on account of their influence in rendering dry air a conductor of electricity. Professor J. J. Thomson, of Cambridge, claims to be able to detect with certainty, by electrical methods, quantities of radio-active substances less than one hundred-thousandth part of the least quantity which the chemist could detect by any method of analysis known. He stated in his lectures, delivered at Yale College some eighteen months ago, that the quantity of these radiations, which could be detected electrically, were to the quantity of any known element (so called), which could be detected by ordinary chemical analysis, in the proportion of a second to a thousand years!

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Since the discovery of the Röntgen rays, in 1895, the properties of emanations from the mineral substances uranium, thorium and radium have occupied the attention of scientific investigators; and it is to them that we owe the new ideas and conceptions of matter as capable of existence in even a more attenuated condition than the atom. From the phenomena connected with the emission of rays and emanations from these radio-active bodies, it is evident that they consist of particles infinitely more minute than atoms. The emission of atoms themselves seems quite intelligible; as matter, in many forms, can evaporate, and some substances emit a perfume which is certainly appreciable to the lower order of animals if not always to human beings. No one has seen a smell, nor the wind, nor the minute particles worn away from a pavement, yet no one doubts the existence of these particles. But, in the case of the emissions from radio-active bodies, their speed is found to be enormous, and their atomic weight something like one-thousandth of the atomic weight of hydrogen. The atom of matter must therefore be considered as complex, not simple, and composed of a number of smaller bodies, interleaved and interlocked and in a state of rapid motion. Occasionally an atom loses one of these minute constituent parts, which becomes separated from it (chipped off, as it were) and flies away at a speed which Sir Oliver Lodge has calculated as being many thousand miles a second: these portions thus separated are known as the α rays. But this rupture of the atom is immediately followed by a further splitting off of other parts of it, which are so minute as to be able to penetrate through solid bodies; and yet a third or ethereal emanation, called the γ rays, follows as a consequence of the break up of the atom. What, then, are these minute portions which the experimental physicist can recognise, handle and investigate? They may be called the corpuscles or electrons, and are of the order of many thousandths of the magnitude of an atom of matter, which is commonly estimated as being about one fifty-millionth of an inch in diameter. Sir Oliver Lodge has given an illustration of the size of these corpuscles by asking one to imagine an atom of matter magnified to the size of an ordinary church, when its constituent ions would be represented in size by a full stop—.

This research into these striking but obscure forms of radiation has laid the foundation of a new hypothesis regarding the constitution of all matter. The phenomena of radio-activity have been found not to be confined entirely to the elements uranium, thorium, etc., which possess this property to a remarkable degree, but to be common to a great number of things, possibly to all things material. It has been found that certain mineral springs are radio-active; rain, snow, hail, the air of cellars, the air contained in many soils, and the atmosphere itself possess the same properties. Indeed, it might be said that corpuscles or electrons are everywhere about, incessantly streaming

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from the earth, from the ends of branches, from rails, from telegraph poles, and from the sun itself. These particles, too, are all of the same nature, size and kind, no matter from where they may come ; and it seems likely that they constitute the primordial form of matter, various combinations of which, interlocked together, go to make up what, up to now, have been looked upon as the elements, of which some seventy or eighty are recognised by chemists. Does this mean that the ancient alchemists were not so very far wrong after all in their belief that one form of matter could be converted or transmuted into another? It seems so, for, in experiments conducted in London by Sir William Ramsay, the emanation from radium was found to have lost its characteristics on standing for a week, and to have developed the properties of a known elementary substance, the gas helium! The radium emanation had become destroyed, altered—degenerated, one might call it—into another form of matter.

What interpretation, then, can be put on these results regarding the fundamental constitution of all material things? The existence of bodies infinitely smaller than the smallest atom has been clearly demonstrated, and, for many reasons, it has been concluded that they are akin to electricity. Sir Oliver Lodge holds that electricity possesses two of the fundamental properties of matter, namely mass and inertia ; light and electricity have been shown to be closely allied to one another in their mode and speed of propagation. Is electricity matter and is matter electricity? Evidently they are closely related ; and if the corpuscles or electrons emitted are not electricity, they at least are the carriers of electricity. The new conception of matter seems to indicate that it and electricity are one and the same thing, and that the chemist's atoms consist of systems of positive and negative electrons, and of nothing else. If the simplest atom, that of hydrogen, consists of, say, 350 positively and 350 negatively charged electrons, interleaved together and in a state of violent motion within themselves, then some sixteen times as many constitute the atom of oxygen, and other multiples of this the atoms of other elements.

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MEMOIRS.

General John Bayly, C.B., Colonel Commandant, R.E.

General John Bayly, who died at his residence, 13, Royal Crescent, Bath, on 12th March, 1905, was the fourth son of the late Capt. Paget Lambart Bayly, 7th Hussars, cousin and aide-de-camp to Field Marshal the first Marquis of Anglesey of Waterloo fame.

He was born in 1821; and obtained his commission as 2nd Lieutenant in the Royal Engineers on the 19th March, 1839, from the Royal Military Academy, Woolwich, passing out first and receiving the Sword of Honour.

The greater part of his service, no less than 32 years, was passed in the Ordnance Survey of Great Britain.

After receiving his commission he spent a year and a-half at Chatham, and then a few months at Portsmouth, during which period he was promoted Lieutenant. He then served nearly four and a-half years in Newfoundland, returning for a couple of months more to Portsmouth.

On the 21st January, 1846, he was appointed to the Ordnance Survey, receiving his promotion to 2nd Captain in September of the following year. Posted at first to a Division stationed at Wakefield, he was subsequently Division Officer at various places in England and Scotland. In 1864 he was placed in charge of the Boundary Branch in London, where he took a prominent part in supplying information and preparing maps for the Boundary Commission (1867–8) in connection with the Representation of the People Act, 1867. In 1874 he was appointed Executive Officer to the Director General, Ordnance Survey, Southampton (at that time Major-General Sir Henry James, R.E., and subsequently Major-General John Cameron, C.B., R.E.); and he filled that post until the 31st March, 1878, when he was placed on the unemployed list with the rank of Major-General which he had attained on the 1st October, 1877. His intermediate promotions dated:—1st Captain 19. 6. 54, Brevet Major 1. 11. 58, Lieut.-Colonel 26. 3. 62, Brevet Colonel 26. 3. 67, and Colonel, R.E., 14. 12. 71.

Having been promoted Lieut.-General in March, 1882, he was placed on the retired list on the 26th April of the same year with the honorary rank of General after a total service of 43 years, 38 days.

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On the 14th June, 1893, he received the honour of being appointed Colonel Commandant of his Corps, and at the time of his decease was the eldest by age and the sixth senior in that rank.

His work on the Ordnance Survey received well-merited appreciation, and the tribute (typical of many such received by his family) of one who served under him for many years is "To anyone who studied his duty, there never was a better or more just officer." The nature of his employment brought him into touch with purely civil work; in 1868, whilst a Brevet Colonel, he acted as Assistant Parliamentary Boundary Commissioner, and in 1884–85 he was Boundary Commissioner for Scotland under the Redistribution of Seats Act. His long and eminent services in the Survey were rewarded in 1875 by the Companionship of the Bath (Civil Division).

Whilst a 1st Captain, in 1854, he married Jane Coventry Ewing, only daughter of Humphry Ewing Crum Ewing, M.P., of Strathleven, Lord-Lieutenant of Dumbartonshire; he leaves a widow, three married daughters, and one son, the Revd. Paget Lambart Bayly, M.A., vicar of Netherbury, Dorset, who married the Honble. Blanche Louisa, daughter of the thirteenth Baron Inchiquin.

General Bayly was a J.P. and D.L. for Dumbarton, and a Fellow of the Royal Geographical Society and the Society of Antiquaries.

The funeral took place at Lansdown Cemetery, Bath, on the 16th March. The Assistant Adjutant-General, R.E., sent a wreath "as a tribute from the Corps to which General Bayly belonged for so many years and to which he was so much attached." Letters of condolence (expressing great regret at the loss of his distinguished father and deep sympathy with the family) were also sent to his son from other officials at the War Office and from the School of Military Engineering, Chatham; and His Majesty the King, Colonel-in-Chief of the Royal Engineers, graciously commanded his equerry to send a telegram conveying the expression of his sympathy.

LIEUTENANT-GENERAL A. C. COOKE, C.B., COLONEL COMMANDANT, R.E.

THE Corps lost another honoured veteran on the 6th April, 1905, when Lieut.-General Anthony Charles Cooke died in London, in his eightieth year.

He was the son of the Revd. R. B. Cooke, Rector of Wheldrake, Yorkshire, and Prebendary of York Cathedral; and was born on the 15th February, 1826, at Owston, near Doncaster, the seat of his father's eldest brother. His childhood was spent at Wheldrake and at Etton near Beverley; and his early schooldays at Southwell, Nottingham-

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shire, where he was a contemporary of the late Rt. Hon. Sir William Vernon-Harcourt.

When he was thirteen, Mr. Charles Wood (afterwards Lord Halifax) procured him a nomination for the Royal Military Academy, Woolwich, and he was then removed from Southwell to Mr. Miller's school on Woolwich Common. At the age of fifteen he gained admission into the Academy, third of his batch; and two years later passed out fourth, making, with another boy of the name of Inglis, a record in getting through in a shorter time than any of his predecessors.

He was gazetted 2nd Lieutenant in the Royal Engineers on the 17th of June, 1843; and after spending a little more than a year at Chatham, was sent first to Woolwich and then to Devonport. Shortly after obtaining promotion to 1st Lieutenant on the 1st April, 1846, he was ordered to Mauritius, where he spent nearly three years, and thence to Ceylon; in the latter island, during a stay of over two and a-half years, his sporting instincts had full play, including, on one occasion, the bagging of two elephants by a "right and left."

At the beginning of 1852 he came home, and spent two short periods in Scotland and two at York, subsequently being posted to the Ordnance Survey at Newcastle, where a year and a-half saw him promoted 2nd Captain.

On the outbreak of the Crimean War in 1854 he applied for permission to resign his appointment in the Survey; but his ardent desire for active service was not gratified until May of the following year, when he embarked for Malta *en route* to the front. He arrived off Sebastopol shortly after the failure of the attack on the Malakoff, and was posted to the Right Attack; his immediate superior was Captain (afterwards Sir James) Browne, whom he succeeded in his command after the assault on the Redan on the 8th of September, where Browne was wounded. Cooke was twice mentioned in despatches (*London Gazettes* of 5th October and 21st December, 1855); and for his services in the war he received a Brevet Majority, the medal with clasp, the Turkish medal, the 5th Class of the Medjidie, and eventually the C.B. He remained at the seat of war until August, 1856, two months later than his promotion as 1st Captain.

On his return to England he rejoined the Ordnance Survey at Perth. Rather more than two years afterwards he was transferred to the War Office as Executive Officer of the Topographical Department, a new appointment which he held for over ten years, this period covering his successive promotions to Brevet Lieut.-Colonel (11th March, 1865) and Lieut.-Colonel, R.E. (6th July, 1867). During the latter part of his term at the War Office the Prusso-Austrian War occurred, and a study of this campaign during its

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progress enabled him to write a detailed critical account (published in 1867) which received the commendation of von Moltke, whose aide-de-camp, in a letter written "by order" to General Beauchamp Walker (British Military Attaché in Berlin), stated "General von Moltke is particularly pleased with Lieut.-Colonel Cooke's pamphlet on the war. He says it contains the best and most accurate critical remarks he has yet met with."

In April, 1869, Cooke reverted to ordinary duty and was stationed at Chatham for ten months, after which he served three years in Bermuda as Commanding Royal Engineer, obtaining meanwhile a Brevet Colonelcy on 6th July, 1872. In October, 1873, he was appointed Colonel on the Staff, C.R.E., at Aldershot, and on 13th August of the following year promoted Colonel, R.E.; he remained at Aldershot until 1st August, 1878, when he succeeded Major-General J. Cameron, R.E., in the Directorship of the Ordnance Survey, which he held for nearly five years.

While he was Director of the Survey the Government expressed a determination to accelerate the completion of the Cadastral Survey of Great Britain, and he was asked if he could draw up a scheme to complete it by a given year. On this he wrote, "This means doubling the whole establishment. The organization of the Ordnance Survey is such that it is no use seeking the necessary workmen from the ranks of the Civil Engineers. I can depend only on rapidly training a sufficient number of men for the purpose. After some hesitation I determined to answer the question in the affirmative, and sent in an estimate of the necessary funds that would be required year by year for carrying out the work. The sums amount to millions of pounds and the number of employees to thousands"; and later "my estimate and report are approved"; and still later again "the work is completed by the time fixed and at the cost I estimated."

Having been promoted Major-General on 7th April, 1882, he was placed on the unemployed list in April of 1883, but he was granted an additional year in the Survey in order that the work might be continued under his immediate supervision, a compliment which he highly valued. As a reward for this work he was recommended for a Knighthood of the Bath, but for some reason or other never received the honour.

Colonel Duncan Johnston, C.B., late R.E., the present Director General, writes:—"General Cooke never got the full credit he deserved for his work as Director General of the Ordnance Survey. He held this post at a critical period, when the Government wanted the Cadastral Survey completed within half the estimated time. When he undertook to do this it was thought that his undertaking was a very bold one; but so thoroughly and judiciously did he make the necessary arrangements that the work was carried out to the day without any excess of expenditure.

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"There have probably been more brilliant heads of the Ordnance Survey than General Cooke, but none whose work has better stood the test of time. He was most thorough in his work, never giving a decision on any important point till it had been considered from every point of view; and his judgment was so sound that he rarely made a mistake.

"He was of a quiet, retiring and kindly disposition, and habitually courteous to all, but when necessary firm; he was esteemed and liked by the officers who served under him, and always commanded their entire confidence.

"In 1891 he served on Sir John Dorington's Committee on the Ordnance Survey, and contributed by his knowledge and experience to the valuable report of that Committee.

"He always kept up an affectionate interest in the Survey, in connection with which he will always be remembered."

On the 6th May, 1885, he retired with the honorary rank of Lieut.-General after a total service of very nearly forty-two years; and in December, 1899, he was appointed a Colonel Commandant, R.E.

After retirement he lived in London, making frequent excursions to Ireland, Scotland and Norway for salmon fishing, a sport to which he was greatly devoted.

He was a Fellow of the Society of Arts and of the Royal Geographical Society.

The funeral took place at East Stoke, near Wareham, Dorset, where he was buried close to his only sister, the late Mrs. O. W. Farrer. The Assistant Adjutant-General, R.E., Sir Reg. Hart and the officers at Chatham, and Colonel D. Johnston and the officers of the Ordnance Survey sent wreaths as tributes of respect from the officers of his old Corps.

CAPT. A. T. CHAMIER, R.E.

A SAD ending to a promising life was the death from hydrophobia, at Krishnagar, Bengal, on the 15th of March, 1905, of Capt. Arthur Tyrrell Chamier.

He was the youngest son of Lieut.-General S. H. E. Chamier, C.B., Royal Artillery, and was born on the 28th of November, 1871. He was educated at the Royal School at Armagh and at Cheltenham College. Originally intended for Oxford University with a view to service in the Church, he made up his mind, soon after he was sixteen, to compete for entry into the Royal Military Academy, Woolwich, in the hope of obtaining a commission in the Royal Engineers.

He passed into Woolwich ninth of his batch, and was gazetted

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2nd Lieutenant on 24th July, 1891. After two years' instruction at the School of Military Engineering, Chatham, he joined the Indian Establishment. On arrival in India in October, 1893, he entered the Railway Branch of the Public Works Department, and served at Delhi, Lahore and other stations in the Panjab.

Towards the end of the tribal rising of 1897–98 on the North-West Frontier he was attached to the 1st Company, Bengal Sappers and Miners, and served with them during the latter part of the Expedition through Tirah, for which he received the medal with clasp.

On the conclusion of the war he returned to Railways in the Panjab, where he was employed in important works of construction, and received the commendation of his Engineer-in-Chief for his successful performance of his duties.

In 1902 he came home on two years' furlough; but the greater part of this period was spent on special duty in the Office of the Inspector General of Fortifications.

On his return to India in December, 1903, he was attached to the Eastern Bengal State Railway, his immediate charge being the construction of the important Jhallinji Bridge.

During his fourteen years' service he had given proofs of ability much above the average, and the career cut short by his sudden death was certain to be useful and would probably have been distinguished.

The keynote of his character was his strong religious feeling, unobtrusive and unaggressive, but none the less deep and real, carrying with it, as its natural outcome, an ardent devotion to duty and perfect unselfishness.

In his last days, when he knew that his hours on earth were numbered, he thought only of preventing his work from injury, and of lessening the trouble of those about him and the grief of those nearest his heart.

He was perhaps too retiring and too reserved to be popular in the ordinary sense, but it may be said with truth that those who knew him best loved him most.

JOHN PENNYCUICK.

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TRANSLATIONS.

TECHNICAL COURSES OF INSTRUCTION FOR ROYAL ENGINEER OFFICERS.*

1. The course of instruction for officers of Royal Engineers has recently been under consideration in connection with the technical examination for promotion to the rank of captain, and it has been decided to institute the following courses, viz. :—

I. A junior officers' course.
II. A special advanced course for junior officers selected for India.
III. An advanced course for officers other than those selected for India.

} As shown in the annexed Syllabus.

2. It is notified that :—

(i.). All officers on the British establishment, commissioned after 1st June, 1897, who have not done Part II. of the School of Military Engineering Course, will be required to undergo the advanced course in lieu of the Barrack and Active Service Projects referred to in paragraphs 141—179, *R.E. Corps Memorandum, No. 605*, dated the 1st August, 1899.†

(ii.). All officers who were struck off the instructional strength of the School of Military Engineering, Chatham, prior to 14th February, 1899, and officers who have been through Part II. or the special course for junior officers going to India, will be required to undergo the Barrack and Active Service Projects as hitherto.

3. The following arrangements will be made with regard to officers undergoing the advanced or special advanced course :—

(*a*). Officers selected for service in India, including Submarine Miners, will, for the present, be put through the special advanced course before embarking for that country.

* As it may interest officers of other branches of the Army to know what Royal Engineer Officers are taught at the School of Military Engineering, the following extract from *Corps Memorandum No.* 619, of 1st May, 1905, is here published.—EDR., *R.E.J.*

† An officer who has qualified in the Barrack and Active Service Projects before 1. 6. 05 will be exempt from the advanced course.

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(*b*). On completing the junior officers' course at Chatham, officers of Royal Engineers, not selected for India, are either:—

(i.). Sent abroad for a tour of two to five years (*K.R.*, paragraph 1465A).

(ii.). Posted for duty to a unit at home or to Engineer Services.

Those under (i.) would undergo the advanced course on return from foreign service, when they would have a maximum of seven years' service.

Those under (ii.) would, if they had more than three years' service on being ordered abroad, undergo the advanced course before embarkation. As a rule, they would remain three years with a unit, and have nearly five years' service when they do the advanced course.

4. There will be an advanced course each year at the School of Military Engineering, Chatham, lasting about six months. For the year 1905 the course will begin on or about 1st June, and in subsequent years probably on 1st July.

5. Examinations in (i.) Military Engineering subjects, and (ii.) Construction, will form part of the advanced course, and will be conducted in a similar manner to that laid down in the *King's Regulations* for Artillery and Army Service Corps subjects, and officers will be classified accordingly. The Examination Board will be composed of Royal Engineer officers, and will sit at Chatham. It will be convened under the instructions of the General Officer Commanding for a fixed term of not less than one year, if possible, and will consist of a president, not below the rank of lieutenant-colonel, and two field officers or captains. For the examination in Military Engineering, the Commandant, School of Military Engineering, will detail the Instructor in Fortification, or one of his assistants not below the rank of captain, as a member of the Board, and for the examination in Construction, the Instructor in Construction, or one of his assistants not below the rank of captain.

6. As regards the examination in Military Engineering, which will take the place of what has hitherto been called the Active Service Project, paragraph 1, Part I., *Regulations for Royal Engineer Services*, shows the duties of Royal Engineers in War, and, with the addition of "Demolitions and Hutting of Troops" will form the basis for a syllabus of the examination; but the knowledge of railways, telegraphs, balloons, and defence by submarine mines and torpedoes will necessarily be confined to elementary principles. The demolition and restoration of railways and telegraphs will, however, be taught to all Royal Engineer officers.

7. The examination in Construction will comprise—

Written answers to questions on:—

A. (*a*). Principles of Building Construction and Design.

(*b*). Principles of Sanitation.

(*c*). Strength of Materials, with Calculations for Trusses, Girders, etc.

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B. (*d*). Engineer Services.
(*e*). Estimating.
(*f*). Preparation of a Design, with Specification, Approximate Estimate and Calculations.

8. In both of these examinations, a classification similar to that adopted at other military examinations will be followed by the board, viz. :—

·5 for a pass.
·8 for a special certificate.

A special certificate will be necessary to make an officer eligible for accelerated promotion.

9. With a view to :—

(*a*). Stimulating study in and attention to recent engineering practice,
(*b*). Encouraging a candidate to give the results of his own experience,
(*c*). Furnishing the examiners with a comprehensive idea of the candidate's capabilities and qualifications,

each officer will be required to submit a short essay upon some engineering subject dealt with in the course.

The essay will be awarded credit in the general report upon the results of the examination of each officer.

10. Applications of officers to undergo the advanced course will be forwarded by General Officers Commanding direct to the Commandant, School of Military Engineering.

11. During the transitional period it has further been decided to institute a system of allotting a similar decimal to the Barrack and Active Service Projects, prepared by lieutenants of Royal Engineers as a test of their technical qualifications for promotion (*vide* paragraph 2 (ii.) above).

12. In these circumstances, and with a view to securing a uniform standard for the allotment of this percentage, the Project papers of officers —referred to in paragraph 2 (ii.) above—serving elsewhere than in India will, in future, be set, and the Projects be examined and marked, by the standing Board of Officers of R.E. referred to in paragraph 5 above, but the examinations will be conducted locally.

On 15th January, 15th April, 15th July, and 15th October, the Commandant, School of Military Engineering, will send to stations requiring them a set of Project papers under confidential cover.

These will, if considered necessary by the Commanding Royal Engineer, be adapted by him to local conditions before issue to the officers concerned, and the Projects, when completed, will be returned to the Commandant, School of Military Engineering, with the opinion of the Commanding Royal Engineer as to whether they satisfy local conditions in every respect. The Commandant, School of Military Engineering, will communicate the result to the War Office, together with the marks and percentage allotted in each case by the standing board.

13. In regard to officers serving in India, the existing arrangements under which the Projects are set and examined in that country will, for the present, be continued, and the percentage will be allotted locally.

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INSTRUCTION OF R.E. OFFICERS AT S.M.E.—SYLLABUS.

(I.). JUNIOR OFFICERS' COURSE:—

	Days (including Sundays).
Military Training and Duties, including Tactics	116*
Workshops	31
Electricity	14
Fortification	105
Survey	105
Construction	117
Leave and between courses	37
	525†

(II.). SPECIAL ADVANCED COURSE FOR JUNIOR OFFICERS SELECTED FOR INDIA:—

Construction	60
Survey	15
Fortification	15
	90

(III.). ADVANCED COURSE FOR OFFICERS OTHER THAN THOSE SELECTED FOR INDIA:—

Military Duties, including Tactics, Organization and Interior Economy	28
Field and Permanent Fortification, including use of explosives and 2 days' Coast Defence	28
Survey	28
Examination in above, practical and theoretical	6
Construction (including examination)	91
	181

VOLUNTARY COURSES.

Electricity	34
Permanent Fortification, including Coast Defence	14

* Includes time for preparation for "A" and "B" examination.

† This does not include the period during which the officer will be at the School of Musketry, Hythe, viz., about 30 days.

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PORT ARTHUR AND THE QUESTION OF WALLED ENCEINTES.*

By LIEUT.-COLONEL FROBENIUS, *in the Berlin* NATIONAL ZIETUNG, *of 11th February*, 1905.

We may confidently anticipate that the Russo-Japanese War will furnish us with an abundance of data tending to elucidate the solution of important military questions. The Siege of Port Arthur has contributed much towards the science of fortress warfare. This is just as well, since the vagueness which at present characterises the treatment of that subject requires something more than theoretical arguments to clear it up. The Siege, like a storm in early spring, has rendered a useful service in sweeping away much unsound growth in military theory. It has helped us to recognize that the principles of war, confirmed by thousands of years of experience, are not disturbed by the most perfect modern technical inventions.

"At Port Arthur scientific methods of attack, suggested by all the resources of the field engineer, have proved in every instance superior to the dashing assaults favoured by modern military theorists." Such is the conclusion drawn by a writer in the *Cologne Times* (No. 15) at the end of a long article on the Siege. It is evident from a number of minor points in his essay that the writer is not an engineer officer; and this is satisfactory, as tending to show that other arms are taking an interest in fortress warfare and as indicating a change in the views on this subject held by the army in general.

But the author goes astray when he endeavours to prove from the events of the Siege that, in a modern fortress surrounded by a girdle of detached forts, the walled enceinte is superfluous. This unsound view was at one time prevalent in our army, and has had a most mischievous influence on the design of our works of national defence. We therefore consider it desirable to demonstrate the falsity of this theory.

The author puts his case as follows:—"We have no information as to whether intermediate lines (he means intermediate works) had been constructed between the girdle forts. At one point we know that this had been done, at others no continuous enceinte existed. But during the whole course of the siege neither intermediate lines nor enceinte were of the slightest use to the besieged. At the last, both the numbers and the war *matériel* of the defenders were exhausted; the step-by-step defence prescribed by the text-books was out of the question; and after

* Communicated by the Chief of the General Staff. Printed by permission of the editor of the *National Zietung*.

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the capture of the girdle forts a last stand in the citadel became impossible. We may conclude from this that in fortress warfare the relative value of citadels and walled enceintes is not proportionate to the heavy cost of their construction and upkeep in peace-time. The view taken by many authorities, that a girdled fortress is only a great battlefield permanently equipped for war, received abundant confirmation at Port Arthur. In this Siege a continuous walled enceinte would have been absolutely useless."

We might object to this that the author's premises are not proved; we do not know that General Stoessel did not construct an inner enceinte during the Siege. Contrary to all expectations the enemy gave him abundant time to fortify. But from the strength of the garrison we may safely conclude that at the beginning of the war there was no enceinte; and the conduct of the defence tends to shew that the besieged had not the advantage of an inner line.

It is a mistake to suppose that the enceinte does not become useful till the girdle forts are captured, or that its only use is to oblige the enemy to begin his attack afresh after he has penetrated the girdle. It has long been recognised that the defender must put his whole strength into the defence of the forts, and must not attempt to reserve any portion of his force for the defence of the enceinte. The enciente could not in any case hope to hold out for long after the loss of the forts. The principal *rôle* of the enceinte is played during, and not after, the fight for possession of the forts.

The author's mistake is similar to that of the theorists who, arguing from the successful defence of Sebastopol and Plevna, maintained that field works would form an efficient substitute for permanent fortifications. The object of fortification is not fulfilled by obliging an army to abandon its freedom of movement for the sake of defending a more or less important town; the object is to relieve the field army from the necessity of hampering its movements for the sake of protecting that town. The permanent defences enable the garrison to be reduced to a minimum, leaving the great bulk of the troops free to undertake the far more important duty of meeting the enemy in the field. This leading principle of fortification, economy of men enabling the strength of the field army to be increased, is too often lost sight of nowadays. This is shewn by the author's use of the phrase "a battlefield permanently equipped with war *matériel*." Certainly the ground within and around the girdle is a battlefield; but not for an army. It is intended for a minimum garrison, far inferior in numbers to the besieger, but placed on an equality with him by the permanent means of defence.

The essential difference between the tactics of the field army and those of the garrison is this:—The field army can oppose large reserves to an attack on any point, and can, by their skilful employment, render nugatory the enemy's success if he breaks through the line. The garrison has no such reserves of men; it has to use instead a reserve of fortified works in the shape of an inner line, which can be held by a relatively small number of men. This is the true function of the walled enceinte.

This power of defending inner lines is more important to the fortress

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than to the field army. For the central kernel of the defence contains the stores of provisions, ammunition and *matériel*, which are indispensable to the defence; it contains the men's barracks and the headquarters of the besieged force. But for the enceinte it would be necessary to keep a large reserve of troops to protect this centre, which would reduce the numbers available for the fighting line. The "assault-proof" enceinte may be slenderly garrisoned, in view of the serious hazards to which the besieger would be exposed if he ventured to attack it. Its principal use — and that a most important one—is to strengthen the fighting line during the attack on the girdle, both by its material and moral support, and not merely as a place where the defenders can make a last stand when the girdle has been captured by the enemy.

If, in the case of Port Arthur, we assume a girdle 14 miles long and a complete walled enceinte, then the proper garrison would be 10,000 infantry and 5,000 artillery for the 500 guns. (This is on the supposition that 46 guns were taken from the ships and manned by the sailors). Add a mobile reserve of 10,000 men, and we have a grand total of about 25,000. But the actual garrison on the 26th May was 37,000, or a whole division in excess of the number required under the above supposition; and to this total we must add the 13,000 men borrowed from the navy, who finally increased the strength of the garrison to 50,000 men.

The first attack in force, on August 21st to 24th, shewed that the garrison could not afford to dispense with strong reserves kept in constant readiness. For, although General Stoessel had not omitted to provide successive lines of defence by constructing subsidiary advanced works, the Japanese penetrated to the main fort of Wantai and established themselves there; it was only by the vigorous counter-attack of a strong reserve that they were dislodged and that this attack was repulsed.

Although the besiegers were then constrained to adopt the method of steady advance by sap and parallel, they shewed a disposition to attempt the capture of isolated works by assault in mass. The defender need not have expended so many lives on holding unimportant advanced works, had not *the absence of an enciente* kept him in a state of anxiety lest all should be lost if the besieger succeeded in penetrating the girdle. He was therefore forced to keep masses of troops in reserve behind all the outer forts, which extended from the north-west angle of the defences to the east front. These troops were exposed to severe fatigues and heavy losses. As at Sebastopol, it was impossible to provide them with proper protection either against the weather or against the enemy's fire, so that they filled the hospitals with sick and wounded. As a result, the defending forces were used up more quickly than if a walled enceinte had existed. An enceinte would certainly have enabled Port Arthur to hold out longer.

Moreover, according to all accounts, the forts at Port Arthur were by no means proof against assault. This defect could only be supplemented by keeping both the fort garrisons and the reserves behind them constantly under arms. The experience of this Siege will do much to rehabilitate the value of assault-proof defences, which had sunk in military estimation since the introduction of modern firearms. In the future construction of

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defensive works it will no doubt be recognized that not only the salients of the walled enceinte but *all isolated works* must be made assault-proof.

The detailed history of the Siege shews that the fighting there partook more of the nature of a struggle between two armies on a prepared battle-field than between a large force and a small force strengthened by permanent defences.

Moreover, the fact that the besieger had to have recourse to turning movements wherever he encountered assault-proof works shews that only such works can be accepted as satisfactory portions of permanent defences. It is not sufficient to mark the line of the enceinte by an iron railing; we must have an insurmountable obstacle, properly flanked.

If we mean our fortresses to be not battlefields for our armies but strongholds for minimum garrisons, we cannot dispense with walled enceintes. Otherwise we shall be liable to make the same mistaken use of our fortresses as the French did in 1870.

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ORGANISATION OF MILITARY TELEGRAPHS IN AUSTRIA-HUNGARY.*

By First Lieutenant Othmar Kovarik *in the* Kriegstechnische Zeitschrift, *No.* 7, *Year VII.*

In 1869 the organization of Engineer troops for the first time included field telegraphs. The experiences of 1870–71 necessitated a more complete re-organization, which was completed in 1877 and put to a practical test in Bosnia in 1878. Even at that period there were heavy and light detachments; the former (with air line and bamboo poles) for lines of communications, the latter (with $\frac{2}{3}$ air line, $\frac{1}{3}$ cable) for the front. In spite of adverse conditions the field telegraphs were found most efficient.

Austria led the way in more respects than one. In 1872 a signalling school was established at Bruck. In 1875 an excellent field telegraph cable was introduced (0·234-in. diameter, weight per mile 170½ lbs., breaking strain 271 lbs., resistance per mile 29 ohms). About 1890 the cavalry patrol equipment was introduced; this consisted of a small portable case, containing microphone, vibrator and telephone; the 550 yards of light conductor is abandoned after it has been laid, as the thin wire can easily be replaced. The telegraph school, introduced in 1889, forms a good basis for the training of all branches of the service (although only 52 men per year are trained, whilst war requirements are 2,000 men). The interests of military telegraphs are looked after by a branch of the General Staff, as well as by a branch of the War Ministry.

Visual signalling has always received special attention in Austria. A well-managed system existed in 1848–49 with Radezki's army. In 1859 excellent results were obtained in the quadrilateral Verona-Peschiera-Mantua-Legnano, and in 1866 between Josephsstadt and Königgrätz. Dots were shewn by a circular white disc in daytime and by a light at night, and dashes by a square or by two lights. At present the signallers are organised in 23 detachments, and each signalling station consists of five men, three of whom send and two receive messages.

A telephone detachment with 100 miles of line accompanies each Army Corps.

The 7th Section of the General Staff controls the whole of the military telegraphs and signalling. At the head is a specially selected senior officer, who is in wartime called "Director of Field Telegraphs" and is on the Line of Communication Staff.

Contrary to the practice in other states the Austrian telegraph and railway troops are amalgamated in a Railway and Telegraph Regiment.

* By permission of the editor of the *Kriegstechnische Zeitschrift.*

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This is admittedly unsound, but is excused by want of funds. Two battalions were formed in 1883, and in 1900 a third was added.

Peace Formations.

The following regimental formations exist in peace time:—

The Telegraph School.
A Telegraph Reserve Cadre.
The Committee on Telegraph *Matériel*.
A Cadre for Fortress Telegraph Detachments.

The Telegraph School[*] forms part of the regimental staff, and trains field telegraphists for their duties in wartime. The training is quite distinct from that of the railway companies. On mobilisation the school is closed.

The establishment comprises:—1 captain, 2 field telegraphists as instructors, 1 officers' servant. Only those who pass well and show signs of permanent aptitude are promoted to "field telegraphists" (ranking as sergeant-major). All other candidates who have been successful are classed as "telegraph assistants" or "manipulators," and are appointed as N.C.O.'s to the various telegraph detachments. Training begins on the 1st May and finishes in August. Two exercises under service conditions take place each month.

There are also, at Tulln and Budapest, cavalry telegraph courses from the 1st November till June, concluding with a large telegraph exercise under service conditions. These courses are in military respects under cavalry brigade commanders, and for technical purposes under the telegraph branch of the General Staff. They are intended to provide and train the telegraph patrols attached to each cavalry regiment; each patrol consists of 8 mounted men, 4 N.C.O.'s as telegraphists and 4 troopers as orderlies, and has equipment for two offices (which can in cases of emergency be made into four) and 8¼ miles of cable carried on 8 pack horses.

The Telegraph Reserve Cadre forms a reserve for all the detachments necessary in wartime; it keeps the roster of and trains Reserve telegraphists and assistants. The Commandant is a technical adviser in field telegraph matters to the Regimental Commander. The establishment is:—1 captain, 1 subaltern, 3 N.C.O.'s for administration, 1 section leader, 2 pioneers, 2 officers' servants.

The Committee on Telegraph "Matériel" is responsible for the efficiency of all stores.

The Cadre for Fortress Telegraph Detachments forms a nucleus for certain arrangements in fortified places, particulars of which are kept secret.

Organization in the Field.

The advantages of electrical transmission of messages are pointed out in the Austrian Field Service Regulations. To provide communication for an army in the field there are telephone detachments as well as field

[*] At Korneuburg, near Vienna.

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telegraphs. Telephones replace telegraphs in connecting Army Corps headquarters with its train and with Divisional headquarters; they supplement telegraphy on the field of battle (medical, ammunition supply, captive balloons, etc.), and also along field railway sections, each of which has a telephone detachment providing 6 offices and 18½ miles of line. Whilst cavalry telegraph patrols connect the advanced reconnoitring bodies with the cavalry commander, cavalry telegraph detachments connect the cavalry commander with Army headquarters. Army and Corps telegraph detachments provide for communication between columns of an army, whose advanced troops also get into touch by means of the cavalry telegraph detachments. Reserve telegraphs provide for the more permanent lines, extend the existing system of the country, and connect it with the field telegraphs.

Reserve telegraph detachments can erect 3½ to 4¾ miles a day. 1,100 yards of cavalry telegraph line can be laid or reeled up in 18 minutes, and 1,100 yards of field cable in 24 minutes.

Field lines are protected:—(1). By making communal districts responsible for lines within their zones. (2). By patrols. (3). By a strict observance of the regulations, which lay down that troops are not to damage lines, and are to repair any damage they see or report it to the nearest telegraph office.

All commanders to whom field telegraphs are allotted, as well as their superiors, use the lines for orders and reports. Lesser commanders, such as those of units, reconnoitring bodies and patrols, only use them for transmitting reports. All other official messages have to be submitted to the commander to whom the telegraph office is allotted, who may permit their transmission if he considers them urgent. Important messages must be wholly or partly in cypher; and care must be taken that no opportunity is given to the enemy of gaining information. A supreme commander, or a commander of an independent army, may sanction the periodical transmission of private telegrams, but official messages must never be delayed for this purpose. Private telegrams, whether sent by inhabitants or by members of the army, are always carefully censored before transmission by the Chief of the General Staff or by an officer deputed by him. The Line of Communication Staff may only *visé* messages when no higher staff is present. Further details are given in the *Regulations and Instructions for Field Telegraphs.*

The vehicles comprise:—

1. Field telegraph store wagon, pattern 1890, for Corps and Cavalry telegraph detachments; carrying only cable; drawn by 4 horses and weighing loaded 2,463 lbs.; track 3 ft. 10 in.

2. Field telegraph wagon, pattern 1897, similar to the above, and for the same purpose.

3. Field telegraph office wagon, equipped with 2 offices complete and with room for 1 office on the wagon; drawn by 4 horses, weight loaded 2,017 lbs., track 3 ft. 10 in., used by all field telegraph detachments.

4. Submarine cable wagon, with 1,100 yards of cable on drums; drawn by 4 horses, weight loaded 1,800 lbs., track 4 ft. 5 in., for Army detachments.

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The following are formed on mobilisation:—

3 Army	Telegraph Detachments.	
14 Corps	,,	,,
8 Cavalry	,,	,,
2 Independent	,,	,,
3 Mountain	,,	,,

The *Director of Field Telegraphs* is on the staff of the Lines of Communications, and has under him 1 staff captain, 1 civilian telegraph official, 1 N.C.O. as clerk, 1 field telegraphist, 1 travelling office horsed by the transport corps, and 1 wagon for the civilian official.

Field Telegraph Sections.—One with each army. Establishment:—1 senior officer as Commandant (with 3 horses), 2 civilian officials (one in charge of the Reserve telegraphists), 1 mounted subaltern (as adjutant), 1 paymaster (with clerks), 1 telegraphist, 4 officers' servants and drivers for the 4 horses with the office wagon, and a requisitioned carriage for the 2 civilian officials and the paymaster.

Field Telegraph Detachments.—Each is divided into construction and transport detachments, and is commanded by a captain or subaltern of the Railway and Telegraph Regiment (with cavalry troops a cavalry officer). Except with cavalry, each detachment is independent for administrative purposes.

These Detachments are allotted as follows:—

(*a*). One with the supreme Commander, consisting of:—Construction, 1 officer, 4 telegraphists, 25 men, 1 officer's horse; Transport, 10 men, 17 horses, 2 office and 2 store wagons, each 4 horsed; 6 offices, 5 miles air line, 2½ miles cable.

(*b*). One with each Army, consisting of:—Construction, 3 officers, 18 telegraphists, 172 men, 3 horses; Transport, 1 officer, 89 men, 150 horses, 6 office and 24 store wagons, 1 wagon for submarine cable, 1 baggage wagon and 1 supply wagon; 12 offices, 60 miles air line, 30 miles field cable, 1,100 yards submarine cable.

(*c*). One with each Army Corps, consisting of:—Construction, 2 officers, 9 telegraphists, 54 men, 2 horses; Transport, 26 men, 42 horses, 3 office and 6 store wagons, and a 2-horse cart for supplies; 6 offices, 30 miles cable.

(*d*). One with each Cavalry Division, consisting of:—Construction, 1 officer, 6 telegraphists, 34 men; Transport, 16 men, 26 horses, 2 office and 4 store wagons; 6 offices, 47 miles cable.

(*e*). Independent (as also fortress) detachments are also formed in accordance with special instructions. These consist of:—Construction, 2 officers, 4 telegraphists, 48 men, 2 horses; Transport, 16 men, 26 horses, 2 office and 4 store wagons; 4 offices, 10 miles air line, 5 miles cable.

(*a*) forms one and (*b*) six working parties of 3 N.C.O.'s and 20 men each; (*c*) forms three and (*d*) two working parties of 2 N.C.O.'s and 10 men each. The remainder of the men march with the staff details; they form a reserve for the working parties, provide the linemen for

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maintenance, and occasionally act as orderlies for the office. Field telegraphists and working parties ride on the telegraph wagons.

Mountain Telegraph Detachment.—Stores are carried on pack animals. Establishment:—1 officer, 31 men, 2 horses, for construction; 34 men, 7 horses, 30 pack animals, for transport; 4 offices, 15 miles field cable.

Signalling Detachments are under the chief staff officer of the particular body of troops they are with. Establishment: — 2 mounted officers, 9 N.C.O.'s and 16 men of infantry. Two country wagons or 7 pack animals carry equipment for 5 stations, *i.e.*, for Nos. 1 to 4 (station No. 5 only being used in case of necessity). Their training lasts two months; it is carried out by Army Corps, and supervised by an officer of the General Staff.

It is under consideration to replace the signalling detachments by allotting infantry telegraph patrols, with 3 offices, 44½ miles of conductor and modern visual signalling apparatus, to each infantry division, independent brigade or body of troops operating in mountainous country. These patrols would be under the General Staff, and would be subdivided into 3 sections, each with 1 store wagon.

Reserves.—Besides a telegraph reserve company there would be reserve telegraph detachments in accordance with requirements. Establishment:—1 official, 1 superintendent, 50 labourers and reserve operators, all provided by the civil telegraph administration of the State; *matériel* carried on requisitioned country wagons. In an extensive theatre of operations such reserve detachments might be under their own field telegraph directors.

Although the Austro-Hungarian organisation of military telegraphs appears to meet all demands of a future war, the existing peace establishment is quite inadequate and has to be made up to war strength with 80 per cent. of reservists and 30 officers not on the active list.

G. B. ROBERTS.

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REVIEWS.

THE LIFE AND TIMES OF MAJOR-GENERAL SIR JAMES BROWNE ("BUSTER BROWNE").

By GENERAL J. J. MCLEOD INNES, V.C., R.E.

Among the many distinguished men who left Addiscombe to join the Indian Engineers, amalgamated in 1861 with the Corps of Royal Engineers, probably there has been none of such varied attainments as the subject of this memoir. There have been great soldiers like Lord Napier of Magdala, great engineers like Sir Arthur Cotton, and great administrators like Sir Henry Durand; but Sir James Browne was distinguished in all three branches. He was, moreover, a man of marked scientific attainments, a linguist of wide range, a mathematician of no ordinary calibre, a wise and far-seeing statesman. When we add to the above that nature had endowed him with a herculean frame, a rich and sonorous voice and good ear for music, and a peculiar power of attracting the regard and affection of his fellow men, it will be admitted that his biographer has indeed a difficult task to perform in presenting an adequate picture of so varied a character from the *embarras de richesse* of the subject.

General Innes, whose own brilliant military career, in so far as active service was concerned, had ended before Browne had even arrived in India, has taken a somewhat new and most interesting method of treating his subject. Instead of writing, after the fashion of most biographers, a detailed account, interspersed with letters and diaries, of the life of the man whom he desired to depict, and alluding to public events only in so far as they touched the career of the individual, he has chosen to trace the public events themselves as regarded from the standpoint of an official high in the Indian service, and to show how Sir James Browne was an executive agent in carrying out the orders of the rulers of the land. In this way he has most successfully described the *service* of the subject of his memoir, a service which was rendered in the highest and

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most honourable manner, free from self-seeking and individual ambition, but at the same time with a clear perception of what was of lasting importance as distinguished from mere transitory expediency. This perception of essentials at times led Browne to take upon himself heavy individual responsibility, and even to violate regulations, but this was always done in the true interests of the State which he served throughout with unswerving loyalty.

James Browne reached India just at the period after the Mutiny when the old *régime* had necessarily to be replaced by other measures. General Innes has most clearly shown how the paying off of old scores on the frontier and Browne's employment thereon gave the latter the foundation for the important work which he subsequently carried out in that part of the world, and with which his name is now chiefly associated. The Mahsud Waziri Campaign of 1860 and the Umbela Campaign of 1863, in both of which he did admirable service and had much hard fighting, brought him into touch with some of the best soldiers of the day, and taught him much about the nature of the tribes and the lessons of war.

In the intervals of these campaigns he had engineering work to do, the scope of which is most astonishing. The Kohat division, of which he was made executive engineer, appears to have been in those days of enormous size. In fact the extent of his charge would appear to have been almost as large as that of the C.R.E. of the N.W Frontier to-day—a task of no little magnitude for a Lieutenant! It must be remembered too that there were then no such means of communication as exist now, when roads and railways cover the face of the country.

After Kohat he had the executive charge of Kangra, where he speedily made his mark as a great mountain road maker and bridge builder.

The bridges he designed and built were of every variety, and some indeed are among the finest specimens of the art of the *pontifex maximus* that are to be seen anywhere. Stone bridges of a greater span than 140 ft. are, indeed, to be found in other parts of the world; but Browne is, so far as we know, the only engineer who has built bridges of that span with bricks burnt in his own kilns,—a bold feat for a sapper subaltern! It was no mere guess work. Every step he took was founded on thorough mathematical investigation coupled with careful practical experiment, and, as he often told the writer, each successful step he thus took gave him fresh confidence for other and further designs. He delighted in scientific engineering, it was to him a charming combination of mind and matter, a conquest of nature by study of her laws, a subject of infinite variety and infinite expansion. And in this his great mathematical powers were of incalculable value. He had not the mere bowing acquaintance with the calculus that some of us have; he grasped it as a valuable tool, and used it with the skill of a master.

It may be interesting to officers in the Corps to know that after his death Lady Browne sent the writer several of his bridge plans. These are now in the office of the C.R.E., N.W. Frontier at Peshawar.

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The Institution of Civil Engineers awarded him the Telford Medal and Premium in 1871 for a paper on Mountain Roads.

On reading the account of the engineering works open to the Corps in the sixties and early seventies, it is curious to notice how times have changed. Then the chief engineering works entrusted to the military engineer were in connection with irrigation—a branch in which Browne never was employed. Railways were mostly in the hands of the special men sent from home by the guaranteed companies. Barracks and roads were, as now, largely in the hands of military engineers, but water supply projects and other sanitary schemes were almost unknown. Nowadays irrigation has passed out of our hands, but our officers find their work on railways, roads and barracks, on water supply projects and drainage schemes, a wider field in many respects than that which was open to them in the early days.

Browne very soon made his mark as a railway engineer when that class of work was thrown open to the Corps. He studied the subject both theoretically and practically while on furlough; and, his fame as a bridge builder in Kangra having paved the way to further distinction, he was employed to design the Indus bridge at Sukkur. His design, it is true, was not accepted, but the details and calculations elicited the highest praise from the Consulting Engineer at the India Office, who said that they evinced "a rare combination of theoretical skill and practical talent."

From this employment he was sent by Lord Lytton to survey the country between Sukkur and Sibi in Beluchistan. How this led to his employment in a semi-political capacity, by utilising his linguistic powers and well-known influence over the wild frontier tribesmen; how this further led him to be selected as political officer in the Southern Column in the Afghan War; how that column, unlike those in Northern Afghanistan, was entirely unmolested by the tribes; and how he eventually led part of it back to India through an unknown route, has all been fully and graphically narrated by his biographer.

To revert to military employment was quite congenial. He was not one of that class of officers who look upon the engineering arts of peace as their sole, or even principal, duty. He was essentially a leader of men; and whether he led them—as he did in sublime audacity—to the capture of a stronghold like Khelat-i-Ghilzai or charging a battery at Tel-el-Kebir, or to the tussle with nature in a big bridge or a stiff bit of tunnel work, his leading characteristic differed only in degree not in kind. He was probably never happier in his life than in the early days of Umbela, in daily danger. It was all like a big game of football to him and he dearly loved the rough-and-tumble.

But the greatest work he ever accomplished was the making of the Harnai—or, as it is more correctly called, the Sind-Peshin—railway. In connection with this, however, his biographer has made one or two mistakes. As the writer of this review was Sir J. Browne's personal assistant during the greater part of the period in question, he considers he is in a position to point them out; and in justice to others it is desirable that they should be mentioned. The route of the railway was,

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it is true, originally reconnoitred by Sir R. Temple in 1879; but it is incorrect to say that "between that date and 1883 more detailed, but still only preliminary, surveys and proposals for the route and the work were sent in to Government . . . they were quite worthless and misleading," etc. This is hardly fair to the officers who were employed on what was in 1880 called the Kandahar State Railway. As a matter of fact the whole of the line was laid out and properly surveyed as far as Khanai (33 miles from Quetta); and with the exception of the Chappar Rift, Mud Gorge, and "The Summit Portion," it was executed under Browne in accordance with the original plans. These surveys were of the greatest possible use to him. The work had not merely been surveyed but had been begun in 1880, some staff quarters built, and a considerable amount of plant collected. Unfortunately the guillotine stoppage of the works by order of Mr. Gladstone had a most disastrous effect both on the people of the country and on the actual work, so that three years afterwards it was in some places more dangerous than if it had never been touched, but that was not the fault of the early engineers.

Again, the rival route, O'Callaghan's Bolan line, has been incorrectly described. General Innes says that this "line runs for the first forty miles with a fairly good gradient, and, although liable to be flooded, . . . is in ordinary seasons an excellent working railway. The steep gradient in the higher part of the Pass prohibits the construction of a broad gauge line and the last part is on the mètre gauge up a very steep incline. . . . It is now proposed to substitute for this narrow gauge portion a broad gauge line on another system, and when this is carried out there will be two broad gauge lines from India to Beloochistan." As a matter of fact the Bolan line was absolutely wiped out a few years after its completion. The remains of the road can still be seen in places, but to all intents and purposes the money spent on it was thrown away. Another broad gauge road, a double track moreover, called the Mushkaf Bolan, begun in 1891 and finished in 1897 by one of Browne's men, Mr. James Ramsay, now connects India with Quetta, in addition to Browne's own line which is just as good to-day as ever.

The story of the construction of the Harnai line has already been told in the *Royal Engineers Professional Papers*, in the columns of *Engineering* and in the *History of the Royal Engineers*, but no words can describe it adequately. Such a record of difficulties from pestering interference from above and pestilence, cholera, scurvy and fever from below, strikes of workmen, unusual floods and landslips, insufficiency of food and transport—, added to the stupendous task of pushing through in 3 years 165 miles of a railway which combined every natural obstacle with the most trying of climates—such an undertaking few men have had to face and fewer have carried through with success.

Towards the close of the work, when physical and mental energies had been taxed almost beyond endurance, Browne was further worried by carping criticisms in the Press. There was about that time a flood of misrepresentation concerning the officers of the Royal Engineers, and some of the Indian papers took up this question with peculiar virulence.

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Invidious comparisons were made between the Harnai and Bolan railways, and some of Browne's brother-officers urged him to take notice of these attacks; and although he systematically kept silence, there is no doubt that they annoyed him. Time has vindicated his action with overwhelming force, for, as has already been stated, his work remains as sound as ever.

To-day the traveller whirls in a comfortable first-class carriage over the great bridges and plunges into the tunnels which were then built, and perhaps there is astonishment at the boldness which designed and the skill which executed these works; but only those who took part in the struggle can have any conception of the toil and pains involved, of the courage necessary to persevere, when cholera and scurvy were raging, when nature seemed to gather all her forces against man's puny efforts, and each day seemed to bring forth some new and unexpected difficulty. As one looks back on those times after the lapse of twenty years, one sees in the midst of it all the splendid personality of the Engineer-in-Chief, always cheery, always plucky, always full of resource, a man among ten thousand, towering above his fellows.

Browne then came home for much-needed rest, and thoroughly enjoyed home life, but alas, for the last time. His subsequent tenure of office as Quartermaster-General in India was much occupied with many important little wars, as well as with important memoranda on frontier defence questions and schemes of mobilisation. It was an anxious and busy time as his private letters to the writer evinced.

From this he was taken to succeed Sir R. Sandeman in the responsible position of Agent to the Governor-General in Beluchistan. There he at once made his mark, going to the root of difficulties as he always did. He deposed the savage Khan of Khelat and restored order in a district where much trouble was brewing, and introduced many wholesome and necessary reforms into the administration. There he died in harness, like his two predecessors, at the comparatively early age of 56.

There are a few minor inaccuracies in his biography, which are worthy of notice. The picture at p. 262 is not the "Louise Margaret" bridge, but what used to be known as "Whiteford's High Level Bridge" near Kach. The titles of the pictures at pp. 324 and 348 should be reversed. The epitaph in Rochester Cathedral was not written by the late Dean Hole (though, of course, as Dean he had to approve of it) but by General H. A. Brownlow and the writer, both of whom were the deceased's very intimate friends.

It may interest officers in the Corps to know that although Browne's service, with the exception of the Egyptian Campaign of 1882, was spent wholly in India, he took the keenest interest in the development of Corps work at home. In connection with the course of construction at the School of Military Engineering he sent to the writer most valuable advice, and was delighted to be consulted.

The picture in the Chatham mess is only moderately good. It was painted from a photograph after his death.

G. K. SCOTT-MONCRIEFF.

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HISTORY OF THE RAILWAYS DURING THE WAR IN SOUTH AFRICA, 1899—1902.

By LIEUT.-COLONEL SIR E. P. C. GIROUARD, K.C.M.G., D.S.O., R.E. (Printed for H.M. Stationery Office. Price 4s.).

DETAILED HISTORY OF THE RAILWAYS IN THE SOUTH AFRICAN WAR, 1899—1902.

(Two vols.;—I. Letterpress, II. Illustrations. Chatham: R.E. Institute. Price £2 2s. net.).

The Times Literary Supplement of the 28th April contained a very able review of the above two publications.

The writer forcibly propounds the principle "that the supreme need for our Army is a system of carefully considered plans which shall lay down the general outline of any war in which we are likely to find ourselves involved," and refers to the necessity of considering the part to be played by special services such as the railway staff.

The importance of a properly thought-out railway system in time of war is illustrated by the Franco-German War; and our own Sudan Expedition and the present war in the East are quoted as instances of the effect of railways on military operations. "In South Africa, partly perhaps because the railways were on the whole so well managed and contributed so largely to our final success in the war, very little has been heard about their management except the obvious stories about a few ill-mannered railway staff officers. But the problems which presented themselves are certainly worth record and study. The original staff to cope with these problems consisted of fifteen special officers and two railway companies of Engineers; and the only plans or arrangements made were subsequent to the declaration of hostilities."

The two publications show that "the most difficult task which the Director had was not so much to educate his own staff as to educate the rest of the Army with regard to the proper functions of the railway and the railway staff in war. When this had been done the rest was comparatively easy."

"Another point clearly brought out is the way in which officers and men were improvised for the railway duties required of them and how well on the whole they accommodated themselves to their new duties. There is a great tendency just now for specialization of functions, both in the Army and elsewhere; but good as this tendency is in some respects, the advantage of the general training in self-reliance and willingness to undertake any responsibility, which our public school and former Army training gave, is one not to be overlooked. The specialist is naturally best for his particular job; but if the particular specialist required is not on the spot, as must often be the case, the best substitute for him is not another specialist but the man trained to act for himself in all circumstances, as it has been the glory of our nation to produce both in the Army and elsewhere."

After stating the circumstances under which the *Detailed History* was published by the R.E. Institute instead of by the Government, and

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expressing regret that the latter did not undertake the task, the reviewer says:—"As it is, the earnest enquirer is seriously handicapped by having to get his material from two different publications, and, no doubt owing to the want of uniform system, the editing is not all that could be desired; thus the second part repeats a good deal of what is stated quite clearly in the first part.* The work would have been improved if it had been carefully edited as a whole by somebody not concerned in the operations described, who, while giving full effect to the evidence of the real workers, could clearly bring out the lessons to be drawn from it. There are some important omissions, such as the absence of any allusion to General Plumer's very important operations on the railway north of Mafeking and the general working of the Rhodesian railway, or to the deplorable failure of the Beira railway, the causes of which are well worth consideration by the student of railways in war-time. Lastly, the book suffers greatly from the want of a good index. But it would be ungracious to insist on these defects and forget to pay a warm tribute to the enlightened patriotism of the R.E. Institute in stepping into the breach when the Government seemed to have failed to realize its responsibilities. Their part of the work is admirably printed, and the illustrations, which entirely fill up the second volume, seem to be most carefully reproduced and are of obvious value."

THE DESTRUCTION OF MOSQUITOS.

BEING AN ACCOUNT OF THE DRAINAGE AND OTHER WORKS CARRIED OUT WITH THIS OBJECT DURING 1902 AND 1903 AT ST. LUCIA, WEST INDIES.

By MAJOR W. M. HODDER, R.E.—(Royal Engineers Institute, 1904).

In a pamphlet entitled *The Destruction of Mosquitos*, Major Hodder, R.E., gives an account of the drainage and other works carried out in St. Lucia, West Indies, in 1902 and 1903. An epidemic of yellow fever which occurred amongst the troops in that island in 1901 was primarily responsible for this work being undertaken. Acting under expert evidence, the military authorities decided to adopt means for destroying

* The *Times* reviewer is under some misapprehensions which it is necessary to correct. The official *History* is a general report, the *Detailed History* is what its name implies. The two publications of course cover the same ground; but this was not only unavoidable, it was advisable, one being for the general reader, the other for the technical student. The *Detailed History* is a record, not a study; it does not, therefore, profess to draw conclusions from the work that was carried out; this is left to the reader to do, with the aid of the preface in which attention is invited to some of the lessons to be learnt. It *was* edited by somebody not concerned in the operations described, one who was qualified too by technical knowledge of railway work. The Rhodesia Railways did not come under the control of the Director of Railways of the South African Field Force until after the relief of Mafeking; the Portugese Beira Railway was, of course, never under his jurisdiction. The contrast between the unsatisfactory working of these lines and the comparatively smooth working of those in the rest of the theatre of war no doubt exemplifies the necessity of adopting the principles laid down in the books under review, but the records naturally deal only with the lines under the Director's control. The *Detailed History* was advisedly published without an index, it being decided that a really good one was impossible and that a good summary is better than a bad index; the work is intended for careful and particular reading and not as a book for intermittent reference.—EDR., *R.E.J.*

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the mosquitos, which were very prevalent on the island, and it is this work and other operations carried out later that Major Hodder now describes. The main part of the pamphlet deals with a description of how yellow fever was stamped out in Havana and the habits of mosquitos. The rest of the text deals with the various drainage improvements that were carried out. The results were satisfactory, and it is interesting to note that the malarial returns for 1903 were enormously lower than those of 1901 and 1902.

The pamphlet will be valuable to those, whether lay or medical men, who may find themselves in tropical countries where there are many mosquitos. In view of the importance of this experiment from a sanitary point of view, it is unfortunate that some competent officer of the Royal Army Medical Corps did not take part in the report, as it would have lent it greater weight with the sceptics who believe that mosquito destruction is impossible.—(*British Medical Journal*).

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NOTICES OF MAGAZINES.

Bulletin de la Presse et de la Bibliographie Militaires.

Nos. 499—500.—*28th February and 15th March*, 1905.

Statistic Tables of the Armies of Europe.—This double number consists of 180 closely printed pages, containing tabulated statistics in parallel columns, for comparison with each other, of the military organisation, administration, armament, equipment, area, population and Army finance of 18 different countries of Europe as they stood on 1st February, 1905. It is a marvellous and most valuable compendium of military statistical information; but it seems a pity that 3 more columns, for Belgium herself and for the United States and Japan, could not have been added or substituted for three of those devoted to the smaller European states.

No. 502.—*15th April*, 1905.

Battalion-Surgeon Lefèvre contributes an article on the Psycho-Physiological Study of Musketry. This alarming title covers an attempt to shew by a sort of analysis of the human nature, by separating the animal mechanism of the man from his will power, sensibility and emotional attributes, that the soldier is really (if he only knew it) but a creature of impulse, a victim of circumstance and the sport of passing impressions. The writer argues that it is the want of the chemical combination of his bodily and mental components, which are by nature only mechanically grafted to each other, which is the chief obstacle to the soldier's success as a marksman. The good that he would do, he does not, and the evil that he would not, that he does.

Twenty-five pages of philosophical argument lead to the deduction that the only way to make a man a good shot is to put him through such a strenuous and grinding course of progressive physical rifle exercise during his 2 years' service that the mental intelligence will be crushed out of him and he will become a simple mechanical automaton; that he requires really no aiming over sights to shoot straight, but will automatically snap-shoot correctly at any range just as Buffalo Bill used to break his glass balls with his scatter gun. Some doubt however seems to have arisen whether 2 years' service is long enough for the soldier to attain the desired brain vacuity (probably his life would be all too short); and it is recommended that he should begin his rifle practice very early in his youth.

We may I think congratulate ourselves that our R.A.M.C. officers have not yet taken to setting us right about the psychology of marksmanship. It might perhaps bewilder some of our recruits, and retard the development of that intelligence in the soldier of which we have been hearing so much lately.

G. H. Sim.

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ENGINEERING NEWS.

February 2nd, 1905.

IMPURE SAND IN CONCRETE.—It is somewhat a novelty to hear that the presence of clay or organic matter in sand intended for making concrete is no disadvantage, and further that certain soft fine sand will make good concrete; but such has been the experience of Mr. J. C. Hain of the Chicago, Milwaukee and St. Paul Railway, who has been employed on concrete work of bridges and culverts for some time past. The conclusion drawn is that the usual specification "clean, sharp sand" is not always necessary.

It is true that all sands which contained impurities did not behave alike, but tests extending over three years were generally favourable to those containing foreign matter. Again, Mr. Hain remarks "Washed sand may be less desirable than unwashed. Washing removes the fine particles as well as the foreign matters. The fine grains, if not in excess, are needed to fill the voids of the larger. The only way to decide whether sand should be washed would be to test it under both conditions." In fact, the acceptance or rejection of the sand should depend on briquette tests.

It is interesting to note that some progressive engineers are altering their specifications so as to allow a certain percentage of foreign matters in sand, *e.g.*, "The sand must be free from organic matter, and must not contain more than 10 per cent. of clayey matter. All the sand must be of such a size as will pass through a sieve of ¼-inch square mesh, and shall be of a mixture of sizes satisfactory to the engineer."

It causes one to reflect, perhaps not for the first time, that our specifications are often more rigid than we can really enforce with satisfaction.

C. E. VICKERS.

NATURE.

March and April, 1905.

RADIAL VELOCITY OF THE POLE STAR.—Spectrograms have been obtained at Lick with the large photographic spectroscope during the last eight years to ascertain the "Motion in the line of sight" of Polaris and other (so called) "Fixed" stars.

When a star is bright enough to give an observable spectrum we can ascertain the rate of its approach or recession by comparing the spectrum of the star with that of some substance (say hydrogen or iron) whose lines are present in the star spectrum. Then, if its distance is increasing, its lines will be shifted towards the red, and towards the blue if it is coming nearer. Visual observations of this kind are extremely difficult, the star spectra are faint at best, and the lines themselves often broad and hazy. Photography, by prolonged exposure, gets over the difficulty of the faintness of the star spectra and produces negatives which can be satisfactorily examined at leisure, by clamping the star negative to that

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of the solar spectrum so as to make the lines correspond and thus facilitate the identification of the star lines. By this process the probable error of a star seldom exceeds a mile a second, and is usually less.

In the case of Polaris, the measurements of groups of plates indicated that the velocity of the centre of mass of the rapid pair in this triple system is changing regularly with a period of at least twelve years.

Alpha Tauri has been found by Vogel to be *receding* at a velocity of 30·1 miles a second and γ Leonis *approaching* at 24·1 miles, though the whole distance travelled by these stars in a human lifetime makes no appreciable difference in their direction or appearance.

JUPITER'S SIXTH SATELLITE.—Photographs were taken of Jupiter with the Crossley reflector on December 3rd, 8th, 9th and 10th, 1904; a comparison of them showed that the planet, which was slowly retrograding at the time, was accompanied by an object of the 14th magnitude. Photographs taken on January 2nd, 3rd and 4th showed that the newly discovered object was following Jupiter in such a manner as to suggest its dependence on that body. The above was further confirmed on January 28th by using the 36-inch refractor, the hourly motion of 20″ in R.A. agreeing with the photographic result. The direction of the satellite's motion, although apparently retrograde, cannot be determined until further observations have been made.

SALMON FISHING.—Mr. W. G. Hodgson, discussing certain problems connected with this sport, points out the inaccuracy of the common opinion that the north of Scotland in spring is necessarily colder than the south of England, and then proceeds to discuss the reason why loch-fishing for salmon is carried on with a minnow instead of with a fly. One reason seems to be that salmon lie deeper in the water than trout, and will, consequently, owing to the set of their eyes, see the approach of a boat at a greater distance. A minnow trolled behind a boat is probably, therefore, the best lure for *salmo salar;* but whether the boatmen are right in giving a sinuous course to the boat is questionable. In the first place a boat may be rowed right over a deep-lying salmon without being seen by the fish; secondly, there is reason to believe that disturbed water is conducive to the salmon biting; and thirdly, the fish which takes the trailing lure may not have been lying in the wake of the boat, but may have made a dash from the side. Mr. Hodgson is not convinced that salmon fast during their sojourn in fresh water, and thinks that they take the minnow for a wounded fish, and dash at it owing to the impulse which makes most animals attack a cripple.

THE INDIAN EARTHQUAKE OF APRIL 4TH was clearly registered in the seismograph at the Royal Observatory of Edinburgh. The record began with some minute tremors at 1 a.m., while the larger waves followed about eight minutes later. The maximum disturbance was recorded at 1.30, and was followed by one of almost equal severity a minute and a-half later. From that point the tremors were gradually reduced until 4.43 a.m. The difference of time between Edinburgh and Dharmsala is

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about five hours. Slight tremors have been recorded at Calcutta and Bombay, but no decided disturbance was felt.

ELECTRICAL EFFECTS.—Professor Buller describes some striking electrical effects due to the dryness of the atmosphere at Winnipeg. The air during the winter months contains so little water-vapour that bodies charged with electricity lose their charges very slowly. For a week or more at a time the temperature ranges from 0° to −40F.; very little friction, such for instance as that produced by a person walking on a carpet, will charge him with sufficient electricity to produce a visible and audible spark on touching the gas tap or any other conductor. It is quite easy to light the gas with a spark from the finger by merely shuffling a few paces over the carpet and then holding a finger to the burner! On February 6th, at 1 p.m., when the outside thermometer stood at −5°F. and that indoors at 62°F., Professor Buller found that a spark half an inch long could be obtained between his finger and an earth-connected iron pipe, after sliding his feet smartly for twenty paces along the maple wood floor of the laboratory. In the chemical laboratory *calcium chloride* may be exposed to the air for some weeks without showing the least signs of deliquescence. To demonstrate the deliquescence of this substance he was obliged to use a damp chamber.

W. E. WARRAND.

NEUE MILITÄRISCHE BLÄTTER.

March and April, 1905.

LESSONS OF THE BATTLE OF MUKDEN.—The writer ascribes the Russian misfortunes as being largely due to their original faulty strategic concentration, "a mistake in which pervades the whole conduct of a campaign." This principle is clearly laid down in Blumé's excellent *Treatise on Strategy*, as well as another to which the Japanese success is to be ascribed, viz., "The best chance of success of the Attack over the Defence lies in the simultaneous advance of all available forces against the front flanks of the enemy." Indeed this principle was applied by the Japanese at Lao Yang; but a necessary condition, a superiority of force was not available and the blow, as far as securing a decisive success, was a failure. The battle shows clearly that the Japanese are no longer to be reproached with want of strategic conception, for Nogi's and Kuroki's operations on both flanks were finely conceived, and the former's came quite as a surprise to Kouropatkin and entailed the loss of the campaign. This is all the more remarkable as there were two divisions of Russian Cavalry on this flank under the command of General Mutcheuski, who had hitherto shown himself an active and reliable leader; the movement was known in Europe days before the *dénouement* and was freely commented on in the press. It will remain, with our present knowledge, a lasting reproach against the Russian Cavalry, largely composed, by the

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way, of Cossacks, and justifies the predictions of a well-known authority at the beginning of the war,—that no matter what was the upshot, two popular fallacies would be exposed, viz., Kouropatkin's generalship and Cossack uselessness; that great battles are not to be decided in a day; that the attack of an army in position is an operation in many respects analogous to that of a siege, and that a thorough preparation by heavy Artillery is absolutely necessary if any result is to be obtained by the frontal attack; and that "Le bon Dieu est du côté des gros bataillons" as of yore. Japanese tactics have shown themselves superior on every occasion to Russian. Perhaps Japanese success may be chiefly ascribed to moral superiority—made up of patriotism, contempt of death, order, obedience, frugality and endurance, all of which qualities they have shown in a high degree; indeed in regard to their power of enduring losses it is very questionable whether any army is their equal in this respect.

NIGHT OPERATIONS.—Have always been a feature of war in as far as *la petite guerre* is concerned, and instances are not wanting of its use on a larger scale, of which we have examples in the Seven Years' War and in 1814, not to mention the English operations at Tel-el-Kebir. In the present war many instances can be adduced of the advance of large bodies over extreme and middle ranges during the night, so as to be ready by break of day to undertake the attack over the decisive fire zone. This procedure saves the troops from the losses to which they would be exposed in advancing over these ranges against a well-chosen position, and allows of the attack being commenced by daybreak with comparatively fresh troops, if one can so designate troops who have had but little repose during the night. No doubt the German regulations which prescribe this mode of procedure have been not alone well studied by the Japanese but also well practised, for order, silence, right direction, etc.—indispensable in night operations—are only to be acquired after troops have been trained in a gradually progressive manner, commencing with the company.

PORT ARTHUR.—Major Schroetter, the well-known writer on fortification, has just published an interesting work on this subject, which will be read by soldiers of all Arms, being not merely a dry recital of engineering operations but a work in which many questions of general interest concerning the operations of the war are discussed; he is of opinion, against that of many distinguished strategists, that the Japanese were justified in proceeding as they did, instead of merely blockading the fortress and trusting to famine to do its work. Their great losses he ascribes to over-confidence, owing to their easy capture of the fortress by assault in their China Campaign, and to their want of experience in fortress war, involving imperfect appreciation of the effect of their at first insufficiently powerful Artillery. The long and skilful step-by-step defence before the complete investment reflects the greatest credit on the Russian Army. The surrender was a consequence of physical and nervous depression, brought about principally by the loss of Hill (203) and the death of the Commanding Engineer Kondratensko, whom all admit to have been the Todleben of the siege; under the circumstances

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the continuation of the defence became impossible although considerable material resources were still available.

THE COST OF WAR.—According to the Statistical Department of the Credit Lyonnais the Russian expenses of the war for the 10½ months up to end of 1904 amounted to £88,000,000, the Japanese expenses for the same period being about £72,000,000; in these figures no account is taken of the loss of *matériel* sustained by either belligerent, the Russian fleet destroyed being worth on a low estimate £10,000,000. Some interesting figures are given showing costs of previous wars. The Crimean War, lasting 2½ years, cost Russia £140,000,000; the war of 1877–78, lasting 10 months, cost the same power £128,000,000. The Transvaal War cost £200,000,000, lasting 2½ years. The Franco-German War, lasting 7 months, cost France £88,000,000 and Germany £60,000,000, these sums including only pay of troops and *matériel de guerre*. Indemnity, compensations, etc., have swelled these amounts by many times, as for instance the famous 5 milliards and 2 provinces which unfortunate France had to hand over to the victors—*Va Victis*.

BATTLESHIPS *v.* ARMOURED CRUISERS.—According to a reliable formula adopted by Chief Constructor Kretchner, of the German Navy, the relative fighting values of the following ships are as under:—

		Tons.	Co-efficient or fighting value.
Armoured Cruiser	*Washington* (U.S.) ...	14,700	12·4
,,	*Drake* (E.)	14,320	10·3
,,	*Maryland* (U.S.) ...	14,020	9·6
,,	*Furst Bismark* (G.) ...	10,700	7·4
Line-of-Battleship	*Duncan* (E.)	13,780	22
,,	*Borodino* (R.)	13,730	30
,,	*Suffren* (F.)	12,730	27
,,	*Kaiser Friedrich III.* (G.)	10,700	13·6

Comparing these figures of fighting value with cost and tonnage, it appears that an Armoured Cruiser costs about ⅘ that of a Battleship of the same tonnage, which has a fighting value of between 2 and 3 times that of the Cruiser; and the writer laments that Germany should be spending so much on Armoured Cruisers, when—according to Herr Kretchner's formula—the command of the sea depends on Ironclads.

There are interesting articles on Béton and its application to military purposes, but they contain nothing that is not well known on the subject.

The strategic value of Mukden, the *rôle* of fortresses, field fortification applied to the field of battle, are interesting *résumés* of what is already known on these subjects.

It will interest many students of war to learn that a new Edition (the 5th) of Clausewitz's immortal work *Von Kriege* has just been published with an appreciative introduction by the Chief of the German General Staff, General Von Schleiffen, who says "The teachings contained in it guided the German Army to Koniggratz and Sedan."

R. A. LIVESAY.

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RAILWAY AND LOCOMOTIVE ENGINEERING.

February, 1905.

SINGLE LINE WORKING.—*Train Staffs.*—The use of the Electric Train Staff system for single lines has not yet gained much ground in America, possibly because the cost of installing the apparatus is an obstacle in the way; also the Train Staff system as ordinarily used entails a stop at every Block section to exchange Staffs.

We have here an account of certain mechanical devices for exchanging Staffs without stopping. Such apparatus, adapted for the Webb & Thompson Staff is in use on some British lines; but the pattern of staff here* used is smaller and lighter. It is suspended in a rubber staff case hung from a delivering arm (in much the same way as mail bags are), and is caught by a "catcher" projecting from the engine. The exhibition of the Train Order Signal indicates that Staffs have to be exchanged.

The Santa Fé line uses the Train Staff on some of its sections, and we have here a description of a *Permissive* Staff system, *i.e.*, electric staff combined with tickets. The reason for this arrangement is that, on the section where employed, the balance of traffic, owing to a heavy grade, is all in one direction. Either the *Absolute* Staff or the *Permissive* Staff can be taken out of the same machine, but not both at once. Apparently the train carrying the Permissive Staff may either proceed, follow or go between those having tickets, which is quite contrary to our rules, as in this country, where staff and tickets are used, the Driver who accepts a ticket must always *see the staff*.

The absolute and permissive staffs are of the same general shape, but one is fluted and the other milled.

A somewhat similar "Tablet and Ticket" system is or used to be employed on the Midland Railway between Little Eaton and Ripley (if I remember right). In this case the Tablet had to be put into a certain drawer to unlock the Ticket box, after having been withdrawn from the machine in the usual manner.

C. E. VICKERS

REVUE D'HISTOIRE.

April, 1905.

THE CAMPAIGNS OF MARSHAL SAXE.—The account of the battle of Fontenoy is completed. It is very full and fair, and is supported by a large number of letters and reports, mainly French, but including also those of Marshal Königsegg, the Prince of Waldeck (who commanded the Dutch) and General Ligonier. The writer states the French loss at 7,500, about the same as that of the Allies. The loss of the English infantry was 3,600, while the French infantry opposed to it had 4,500

* Cincinnati, New Orleans and Texas Pacific.

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killed and wounded, and the French cavalry 2,300. Hence he reckons that the English column inflicted twice as many wounds as it received. He ought, however, to have taken the Hanoverians into account, for they formed part of the column, and lost 1,400 men, 44 per cent. of their strength. While declining to follow the French writers, who say that the column was shattered and put to flight, he will not admit that it retired in good order and of its own accord. But Königsegg, a fairly impartial witness, says:—"Seeing at length that the affair was becoming a butchery, and that there was no hope of success owing to the pusillanimity of the Dutch, I advised a retreat, which was made in good order, without the enemy . . . venturing to pursue us." The number of unwounded prisoners taken by the French was very small.

THE CAMPAIGN OF 1800 IN GERMANY.—This chapter is devoted to the generals and the troops of the two opposed armies. The conclusion is that, except in the matter of cavalry and supplies, the Austrian army was inferior in every respect. In describing the antecedents of the French generals, Gouvion-Saint-Cyr seems to be mixed up with his cousin, Jean Baptiste Gouvion, who was born twelve years earlier and was an artillery officer before the Revolution. Gouvion-Saint-Cyr had been an artist, and was one of the most notable instances of men who showed the highest military capacity without previous military training in the regular army.

THE WAR OF 1870–1871.—*Retreat of the Army of Alsace on the Camp of Chalons.*—The appearance of the Germans at Lunéville and Nancy caused Macmahon to renounce his direct line of retreat, by Bar-le-Duc, and move in a south-westerly direction. The infantry of the 1st and 5th Corps took train at Neufchâteau and Chaumont for Chalons, but there was great anxiety lest the Germans, following a straighter course, should cut the line. The cavalry and artillery went by road. The movements are followed day by day from 13th to 20th August; and though there was no fighting, the orders and counter-orders issued are instructive.

E. M. LLOYD.

REVUE DU GENIE MILITAIRE.

February and March, 1905.

THE RÔLES OF INFANTRY AND ENGINEERS AS REGARDS FIELD WORKS.—This article refers to the intrenching equipment of the Infantry and Engineers of the French Army, and enunciates certain principles with regard to their respective *rôles* in executing field works. The writer aims at removing certain erroneous impressions as to what work the Engineers are expected to carry out, and what should be left to the Infantry to undertake.

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Tools, Infantry.—Portable intrenching tools, carried by the soldier, are so few and so widely distributed that practically no effective intrenching work is possible with them alone.

The heavier tools carried in each company cart, together with the portable tools of the company, would suffice for one section to throw up light cover for itself in about an hour, so that an independent company could intrench itself in about 4 hours.

Similarly all the tools in the company carts of a battalion, if collected, would suffice to equip one company, which could obtain effective cover in about an hour and a-half; but this method of working would not be so convenient as that by sections, as the company carts also carry ammunition and their separation from their company is inadvisable. It is calculated that one tool suffices for two men, and that this is the best way for infantry, not trained to digging, to work, one man resting while the other digs.

The Engineer Park of an Army Corps contains tool wagons, each carrying sufficient intrenching tools to provide two companies on the above scale. A battalion could therefore, with its own tools and those of one Park tool wagon, equip three of its companies for intrenching; the fourth company would probably be employed on protection or other duties. Each "section" of the Army Corps Park has three tool wagons, enough to provide a regiment of 3 battalions; and there are 3 sections, 9 wagons in all, in the Park.

The above arrangements do not seem to satisfy modern requirements for hasty intrenching, for only a battalion which can procure a tool wagon from the Engineer Park of the Army Corps can provide cover for itself in less than 4 or 5 hours; and this points to the superiority of an arrangement of portable tools at the immediate disposal of the rank and file in proportion of at least one tool to two men.

Tools, Engineers.—The Engineer company carries enough intrenching tools, mostly heavy but a few portable, to equip each sapper with a pick and shovel. It is laid down in the regulations that the Engineer tools are not available for Infantry use. The Infantry Regulations, 1904, specify that the Infantry must rely on themselves for all ordinary intrenchments, and the preparation of these is in no sense the duty of the Engineers. These will be required for more technical work of overhead cover, abattis, entanglements and communications, or for clearing the field of fire. It follows that for field works the Engineers should be considered as attached to the Infantry, to assist them, and not the Infantry as providing working parties for the Engineers. The latter idea has been hitherto generally prevalent.

The splitting up of the Engineer company by order of the Commander of a mixed force is deprecated. The Officer Commanding the Engineer Company should always have his unit intact and apportion his men to different works and duties as he thinks fit; otherwise he cannot be responsible for the administration and effective work of his company. It is considered that a Brigade is the largest unit that can be served at one time by a company of Engineers. Regret is expressed that the "Chef de Bataillon" (Lieutenant-Colonel, C.R.E.) has been abolished

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from the staff of a Division; the same arguments are adduced as those we have so often heard in our own service in this matter, but they have apparently had as little effect.

Execution of Defensive Field Works.—When the General-in-Chief makes his preliminary reconnaissance of ground to be occupied for defence, he should be accompanied by the senior Engineer officers available, in order that they may be thoroughly in touch with his ideas.

After reconnaissance the General issues his orders as to the positions to be prepared for defence, allots the groups or units of Infantry to their sections, apportions the Engineer Park tool wagons (if available) to the Infantry units, and details the Engineer companies at his disposal, some to assist the Infantry in certain sections of the position, and others to execute special technical works, with, possibly, working parties of Infantry to assist them. Beyond this all details are left to the Commanders of sections of defence. The Section Commanders then make their detailed reconnaissances accompanied by the captains of any Engineer companies allotted to them. They should avail themselves of the latter's technical advice in allocating and designing the defensive works and in tracing them where necessary. But the responsibility of the scheme of defence rests solely with the Infantry Commanders; and the works are executed by the Infantry who are to garrison them, aided in technical matters by the Engineers.

CAMP OF INSTRUCTION AT MAILLY.—The description of the arrangements of the Camp of Instruction at Mailly is given in considerable detail with plans. The site is to comprise a manœuvre ground, rifle ranges and barrack accommodation for

16 Battalions Infantry (4 companies each),
6 Batteries Field Artillery,
1 Company Engineers,
1 Regiment of Cavalry (4 squadrons of 100),

in all 354 officers, 10,700 men, 690 horses.

Later on 24 Batteries Field Artillery and 2 of Horse will be added.

The area of the ground taken up is 28,000 acres, of which one-fourth is covered with pine woods. The ground is diversified with hills and ravines and a river so that variety may be obtained for manœuvre purposes. Eleven farms and a small hamlet had to be acquired, and 2,345 land-owners had to be bought out, of whom 92 per cent. came to terms by private treaty. The cost of the land, including existing buildings, was £282,500 or about £10 an acre.

The site was occupied as a camp for some years, and the plan for the barracks (single-storied buildings to hold one company each) was arranged so that they should cover the same ground as the tents. This enabled the accessory buildings, kitchens, latrines and lavatories for the canvas camp to be erected permanently, and the pipelines and drains to be laid down, so as to be suitable for the permanent barracks when they

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should be built. The disadvantage of this arrangement as compared with double-storied buildings for 2 companies is that the length of pipes and drains is increased.

The buildings face N. and S. and are 40 ft. apart, so as to admit plenty of sunlight between them.

Water supply is calculated at the rate of 10 gallons per man per day and 11 gallons per horse.

Five wells, about 150 feet deep, were sunk near the stream. The first 30 feet were formed by concentric steel tubes, 12" and 16" diameter, with cement grouting filled in between them, by which means the surface water could be kept from filtering into the well. The rest of the well depth was a steel tube 10" diameter.

The water is pumped into 2 reservoir towers, one at each end of the camp, by 3 pumps worked by turbines in the stream close by. Two petrol motors are arranged in reserve in case of the failure of water for the turbines.

Sewers are arranged to carry off all liquids except rain water. The sewage is collected in septic tanks, and the liquid pumped up to a sewage farm situated about 1,000 yards from the camp. The pumping arrangements are very similar to those for the water supply.

The sewage farm contains about 20 acres, divided into seven almost equal sections. The liquid sewage is distributed over a different section each day, so that there are 6 days given for soakage. Each acre is calculated to deal with about 624,000 gallons per year. The farm is let for about £10 a year for each section, about £3 10s. per acre, for a term of 3 years, the chief condition of the lease being that no vegetable is to be grown that can be eaten by man uncooked.

One latrine for each Battalion is provided, containing 10 seats, 2 for N.C.O.'s and 8 for men, with washout closets and up-to-date fittings.

One kitchen serves for a Battalion, and comprises a scullery, 4 company provision stores, and 2 double-company lavatories of 15 basins each. It has a verandah where potatoes can be peeled and vegetables prepared under shelter. The grease traps and surface gullies connected with cooking and washing arrangements are a source of constant complaint, as it is found impossible to get the troops to keep them properly cleaned daily, but the writer has no practical alternative to suggest.

An open double washing trough, 33 ft. long, suffices for a whole Regiment of 4 Battalions. It has a corrugated iron roof, and a drying ground on each side.

Quarters for officers of all ranks have been built, of a very simple pattern apparently, and Brigade mess houses erected, each of which contains the messes of 2 Regiments, with accommodation for over 100 officers. The cost of the quarters and messes is being recouped by a daily contribution from each officer attending the camp.

Barracks for the troops have not yet been commenced; it is intended that they shall be single-storied buildings, measuring 136 ft. × 45 ft., each to accommodate one company of 150 men.

Magazines, stables, stores, and administrative buildings of all kinds have been erected; also a hospital for each Brigade.

G. H. SIM.

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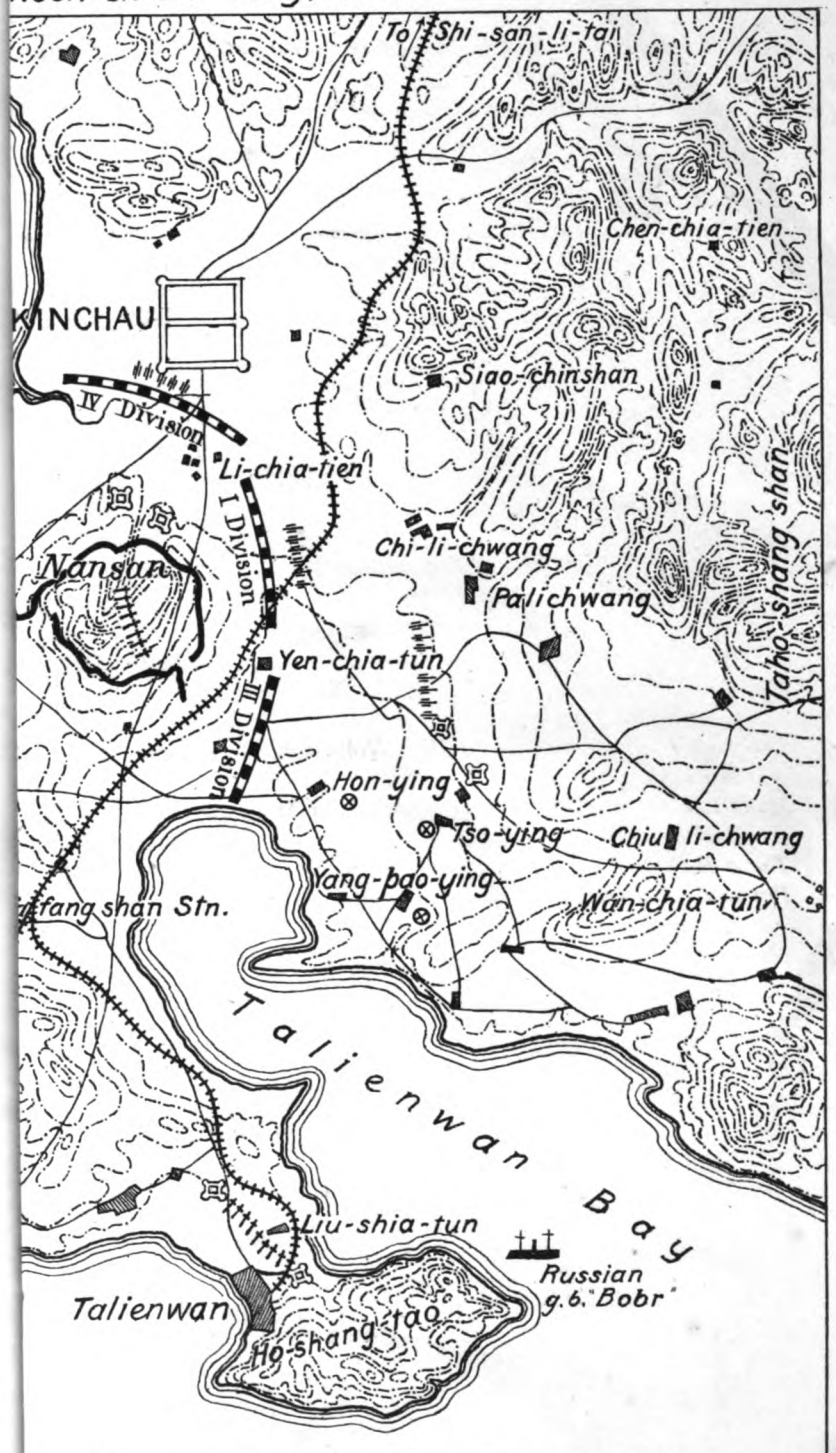

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